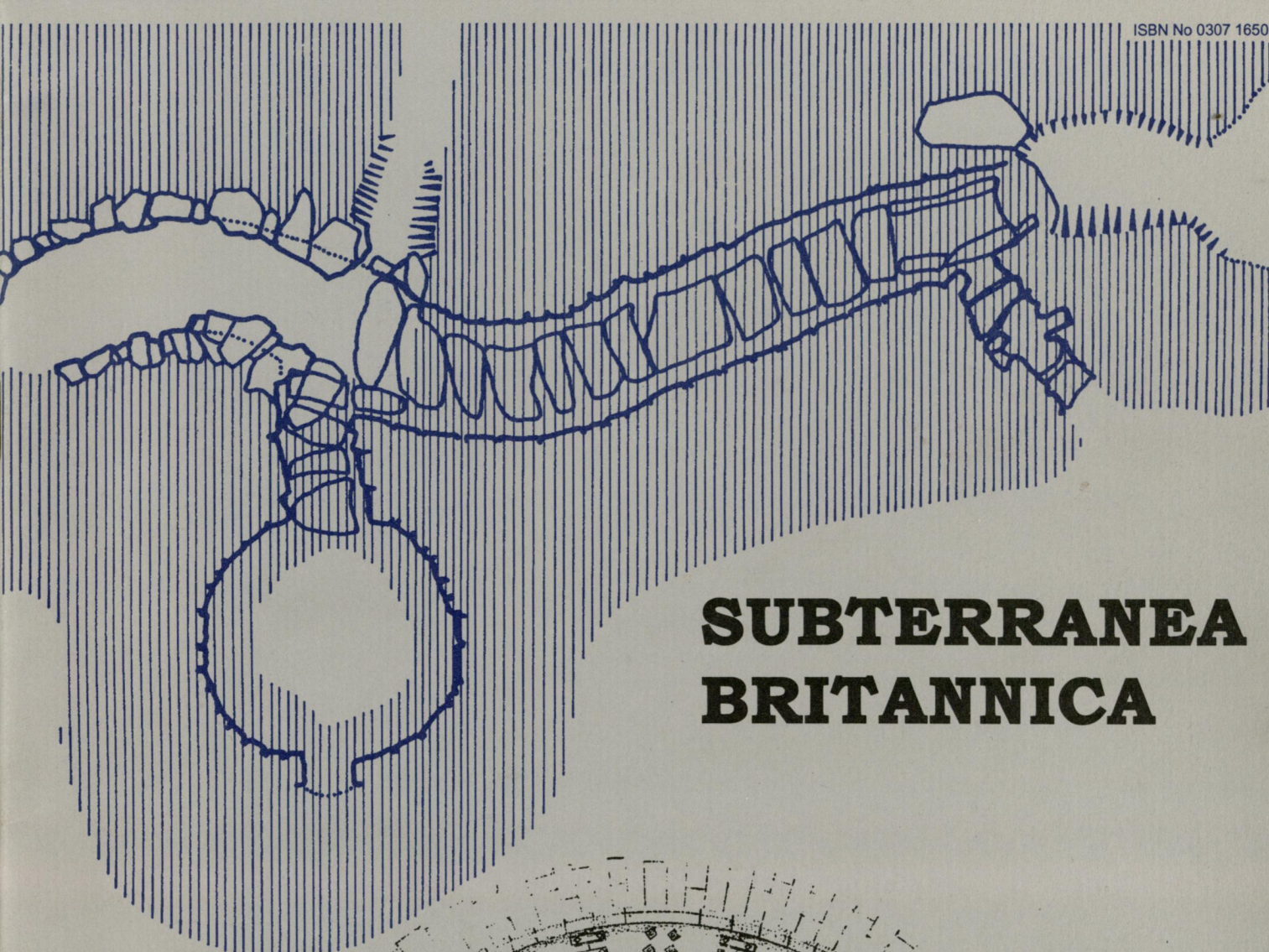
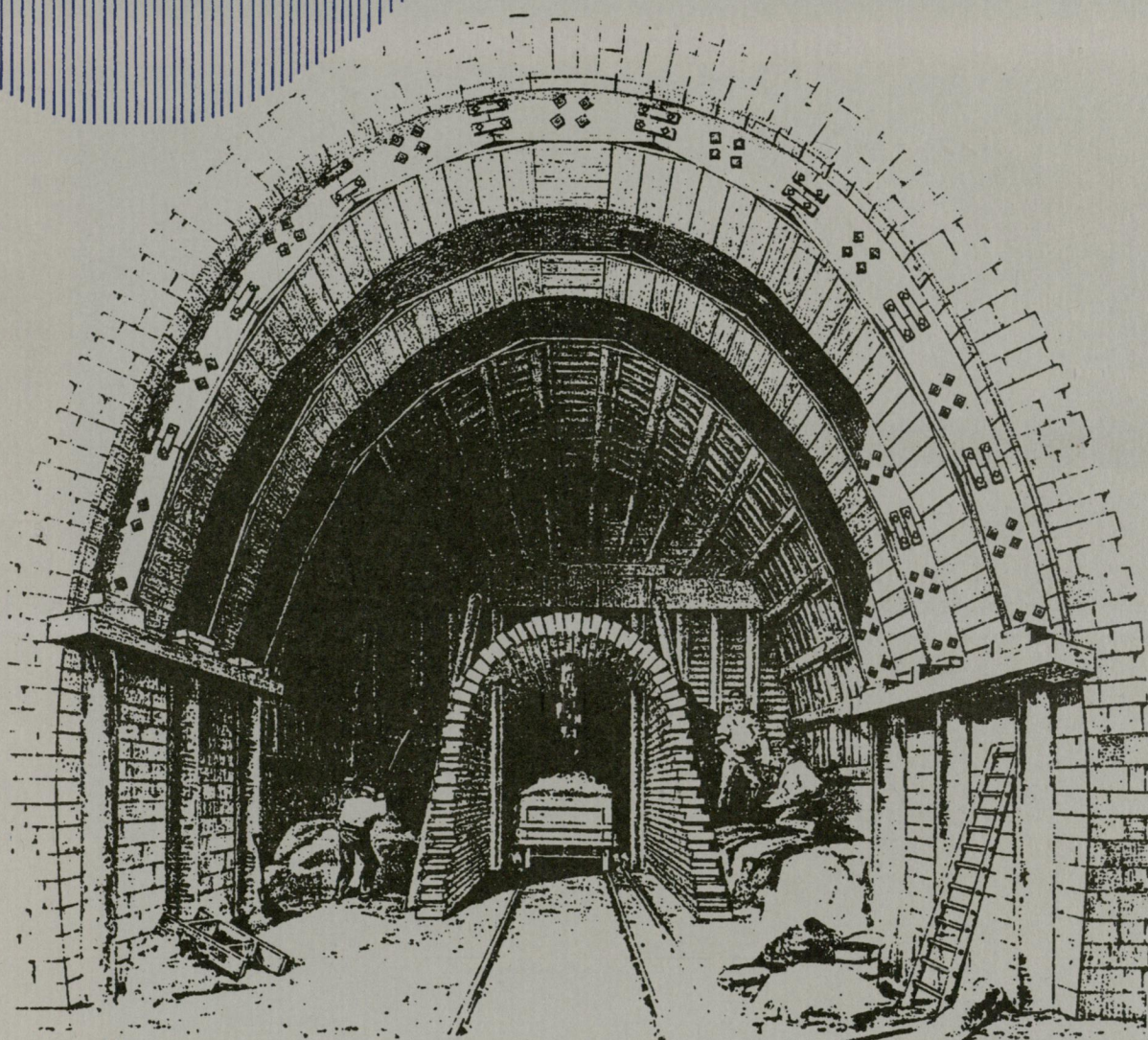




SUBTERRANEA BRITANNICA



Bulletin 31

BULLETIN SUBTERRANEA BRITANNICA 31

WINTER 2000

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*The upper illustration is a stylised representation of souterrain or fogou in Cornwall, the Carn Euny.
Similar structures occur in Ireland, Scotland, and France.
The lower illustration shows the widening from a single to a double-track bore of the Lindal tunnel
on the Furness Railway in 1855 - 1856 (see article.)*

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THE BULLETIN OF SUBTERRANEA BRITANNICA

No. 31 - February 2000

Subterranea Britannica was founded in 1974, for the study of the archaeology and history of man-made or man-used underground spaces and structures. It has formal links and exchange publications arrangements with *Arbeitskreis für Erdstallforschung* (Germany), *Société Belge de Recherche et d'Etude des Souterrains* (Belgium), *Société Française d'Etude des Souterrains* (France), and *Studiegroep Onderaardse Kalksteengroeven* (The Netherlands), as well as less formal links with other groups and individuals in Austria, Belgium, Croatia, The Czech Republic, France, Germany, Iceland, Ireland, Italy, Poland, Russia, Spain, Sweden, and Ukraine.

EDITORIAL

From 1975 to 1985 we published two slender *Bulletins* each year, at first as duplicated or photocopied typescript. More recently we have issued a more substantial compilation annually, using desk-top publishing software and laser printers to produce camera-ready copy. This issue, numbered 31, should have appeared during 1995, the year of our 21st anniversary.

Members' patience during the publication hiatus has been sorely tried, and I apologise to them, and to several authors of papers, for the delay. Regular and at least annual publication will now be resumed and, indeed, we will try to catch up with five missed issues.

Astonishingly, however, the lack of a *Bulletin* for the last five years has not diminished the Society's continued expansion and success. The credit for this belongs largely to the excellent endeavours of our Secretary, Malcolm Tadd, his development of the *Newsletter* and the associated *Siren*, and his work in making our day conferences and study-weekends so successful.

Now that publication of the *Bulletin* is resumed, it is to be hoped that the Society will go on to even further success in the 21st century.

In 1995, I decided to review the then recently issued 'new-style' *Bulletins* (numbered 23 - 30), to assist with planning

future issues. About one third of the papers in those issues described foreign sites. Although we are justifiably proud of our strong links with our colleagues and cognate bodies in several other European countries, I intend to ensure that in future issues the membership's demand for the publication of more British material is met. After all, we are hardly short of sites or of researchers!

I have also considered the subject-matter, and have noted that a number of classes of underground site have been relatively neglected in our *Bulletins* in recent years - canal, railway, and road tunnels; 'cold-war' and military underground sites; and mining and quarrying, for example. The present issue has several items on transport tunnels, and the next will also feature some on mining. I shall be seeking material for publication, especially, with these and military and Cold War subjects in mind. Becoming editor may, of course, result in my writing more papers myself (there is more than sufficient source material in my files, and it is high time it was written-up and published!) But I certainly have no wish to write the whole *Bulletin*, so will in due course be approaching potential authors. Notes for intending authors may be had from me.

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SUBTERRANEA BRITANNICA DURING 25 YEARS A TRIBUTE TO SYLVIA BEAMON

Paul W. SOWAN

Subterranea Britannica was founded on 21st September 1974, at a meeting at Emmanuel College, Cambridge. The Society originated as a result of Sylvia Beamon's work with the National Childbirth Trust, Sylvia quite rightly taking the view that young mothers are just as much in need of and entitled to intellectual exercise as anybody else.

Royston Cave, in the centre of her home town (and one of the United Kingdom's all-too-few Ancient Monuments), became a focus of interest for the group. Sylvia's interest in subterranean medieval carvings soon extended to France, and she became aware of our senior sister society, the Société Française d'Etude des Souterrains.

It was decided to establish a parallel society with similar interests in the United Kingdom, although in the early years the UK membership was mainly drawn from Cambridgeshire and Hertfordshire and, before long, the City of Nottingham.

Going national dates from a meeting at the Institute of Archaeology, London, called by Sylvia on 23rd October 1976. At first, the national Subterranea Britannica was envisaged as a federation of local branches, of which the pre-existing group would become the Cambridgeshire and Hertfordshire Branch. For a brief period we had, confusingly, two committees, two sets of officers, and two constitutions! Fortunately, the federation idea fell by the wayside, and we became a single national body.

The French society's primary focus of interest was at first (and the German society's focus still is) the study of the more traditional underground sites such as crypts, castle dungeons, refuges, 'secret tunnels' and the like, although SFES has more recently also concerned itself with small agricultural chalk mines, and underground building-stone quarries.

SB on the other hand has widened its sphere of interest to include such things as mines of all kinds, transport infrastructure, no-longer secret military and cold war sites, and so forth.

Sylvia (principally) and other officers and members have represented the Society at the Council for British Archaeology, the National Association of Mining History Organizations, etc, and at numerous international conferences throughout mainland Europe.

An early triumph was our own first international conference, held at Cambridge and with excursions to Nottingham and Chatham, 13th - 16th July, 1978. Most of the credit for the success of this and of our second international conference at Bath in 1992 belongs to Sylvia and her husband Alan. From 1979 onwards we have continued to organize an annual Study Weekend, with underground visits, at locations throughout England, Scotland, and Wales.

Sylvia has, also, led the way in serious publication of underground archaeological research, with her books *The ice-houses of Britain* (co-authored with Susan Roaf, 1990, and without doubt the standard work on the subject), and *The Royston Cave, used by saints or sinners? Local historical influences of the Templar and Hospitaller movements* (1992), which has within it much comparative material from other countries in Europe.

Much has happened (and, indeed, ceased to happen) below-ground in the British Isles, the English Channel, and the rest of Europe since Sylvia founded Subterranea Britannica, but the Society has moved with the times in the ever-increasing scope of its members' interests, international links, and use of information technology.

Visit report ...

THE DEEP PUBLIC AIR-RAID SHELTER and UNDERGROUND OPTICAL WORKS at COULSDON, SURREY

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Abstract: A purpose-made deep public air-raid shelter constructed in World War II is described, some seven kilometres south of Croydon, in the Greater London area. The shelter was subsequently used by an optical instrument manufacturing company, but is now derelict.

Keywords: England / London / Surrey / air-raid shelters / World War II / factories / secondary use

INTRODUCTION

The Coulsdon deep public air-raid shelter described here is located at NGR TQ 293585 in fields on the west side of the A23 road, some seven kilometres to the south of Croydon. The site is described, inaccurately, as a 'disused pit' on some Ordnance Survey maps. There are no houses in the immediate neighbourhood, although there are residential areas at and south of Hollymeoak Road some 400 metres to the south, and at and around Lion Green, Coulsdon, just over a kilometre to the north. The main railway line from London to Brighton lies parallel with the main road, on its east side, and Coulsdon South station is a little over 700 metres to the north of the site. There is, currently, a bus stop on the southbound carriageway, near the site discussed. And a public footpath (now becoming very overgrown) from the main road, up the hill beside the shelter site, terminated near the former Cane Hill mental hospital - at a distance of some 300 metres. However, the location seems to indicate that this was a shelter for general public use, rather than one solely for the staff and patients of the hospital. This is confirmed by Arthur Pither (pers. comm.), who recalls being taken from Croydon to the shelter as a child during the war. Presumably the shelter's rôle was as a secure place for the public to sleep at night (as at the Chislehurst 'caves' shelter), rather than a place to which to retreat whenever air-raid warning sirens sounded. Shelterers came

some distance from the built-up areas, largely by public transport.

One of the authors (PWS), in the company of Brian Hillman, visited the shelter, then in an abandoned and derelict state, some time in the 1960s or 1970s. It was at that time open, but has subsequently been sealed and reopened on several occasions. Work on producing a measured survey of the underground tunnels was abandoned when a pile of scale plans of the structure was discovered amongst a mass of paperwork discarded by Messrs. Cox, Hargreaves, and Thomson Ltd., who had used the place as an 'underground optical works.' The following account is, therefore, based both on personal inspection, and on details in the abandoned papers reclaimed.

THE SITE

The roadside site is at the foot of fields which slope gently up the dry valley side towards the west. The tunnels are dug in chalk throughout. The road frontage is about 100 metres, and the east-west extent of the entire site about 200 metres. The lower part, nearest the road, is level and appears to have been intended for the parking of vehicles. It is now overgrown, and partially wooded. An earthen blast bank and ditch (see section and plan) lies between this area and the underground tunnels. Chalk from the tunnels has been piled up on top of the

eastern section to increase the roof thickness. This area is also now wooded. The westernmost limit of the tunnels is ascertainable, on the surface, by the presence of an iron ventilation chimney partially hidden by hawthorn trees part way up the hillside.

Underground, there are three parallel main tunnels, aligned approximately north-west / south-east, running in under the hill. Each of these appears, initially, to have communicated with an entrance into the blast ditch, and had a protective 'dog-leg' at its eastern end as a further blast protection measure. When visited, only the main central tunnel was open to the outside. The central tunnel, the longest of the three, communicates with a small space containing a machine base at the foot of the previously mentioned ventilation shaft; evidently a powered fan was provided. There are two lateral tunnels, linking and at right-angles to the three main ones. Abandoned documentation from the optical works, and some vestigial relics of equipment which might perhaps have been used in connection with grinding mirrors, were found particularly in the northernmost passage. There are also relics of plumbing and sanitation installations.

COX, HARGREAVES and THOMSON's PLAN, SECTION and DESCRIPTION

Amongst the mass of abandoned documentation were copies of an undated leaflet produced by the proprietors of the optical works. The plan, section, and printed description are reprinted here:

'The tunnels are brick-lined, with vaulted roofs, and are 9 feet high and 7 feet wide. The chamber at the north end of the first transverse tunnel is 30 feet long, 10 feet wide and 10 feet high. The large polishing machine, capable of dealing with mirrors up to 80 inches in diameter, is situated in this chamber, and the whole length of the transverse tunnel (235 feet) is available for testing. The length available in the central longitudinal tunnel is 240 feet.'

'The original contour of the ground is indicated by the dotted line in the sectional view. A cutting was made to serve as a roadway giving access to the three entrances, only the central one of which is now used. The sub-soil into which the tunnels were dug is hard, compact chalk and the excavated chalk was spread on the area above the tunnels to a height of 50 feet above the floor level. It is this thickness of earth that maintains the temperature of the tunnel's walls at 54° F (23.3° C) without detectable variation throughout the year.'

'At the far end of the central tunnel a ventilating shaft extends to the surface. An air-conditioning apparatus at C draws air down this shaft and extracts some of the moisture, but does not change its temperature. The air issuing from the lower end of the ventilating shaft is always saturated and at a temperature of 54° F whatever the external temperature and humidity may be.'

An additional document found, Craig Hall & Co.'s *Schedule of condition* (dated 2 March 1950), of which pages 7 - 11 have survived, provides some further information on the state of the deep shelter at that date - generally dirty, dripping with water in places, with vandalised plumbing and lighting fittings, and decayed timber. This identifies the original uses of certain of the spaces, for example ...

East gallery, north section - canteen

East gallery, south section - lavatories

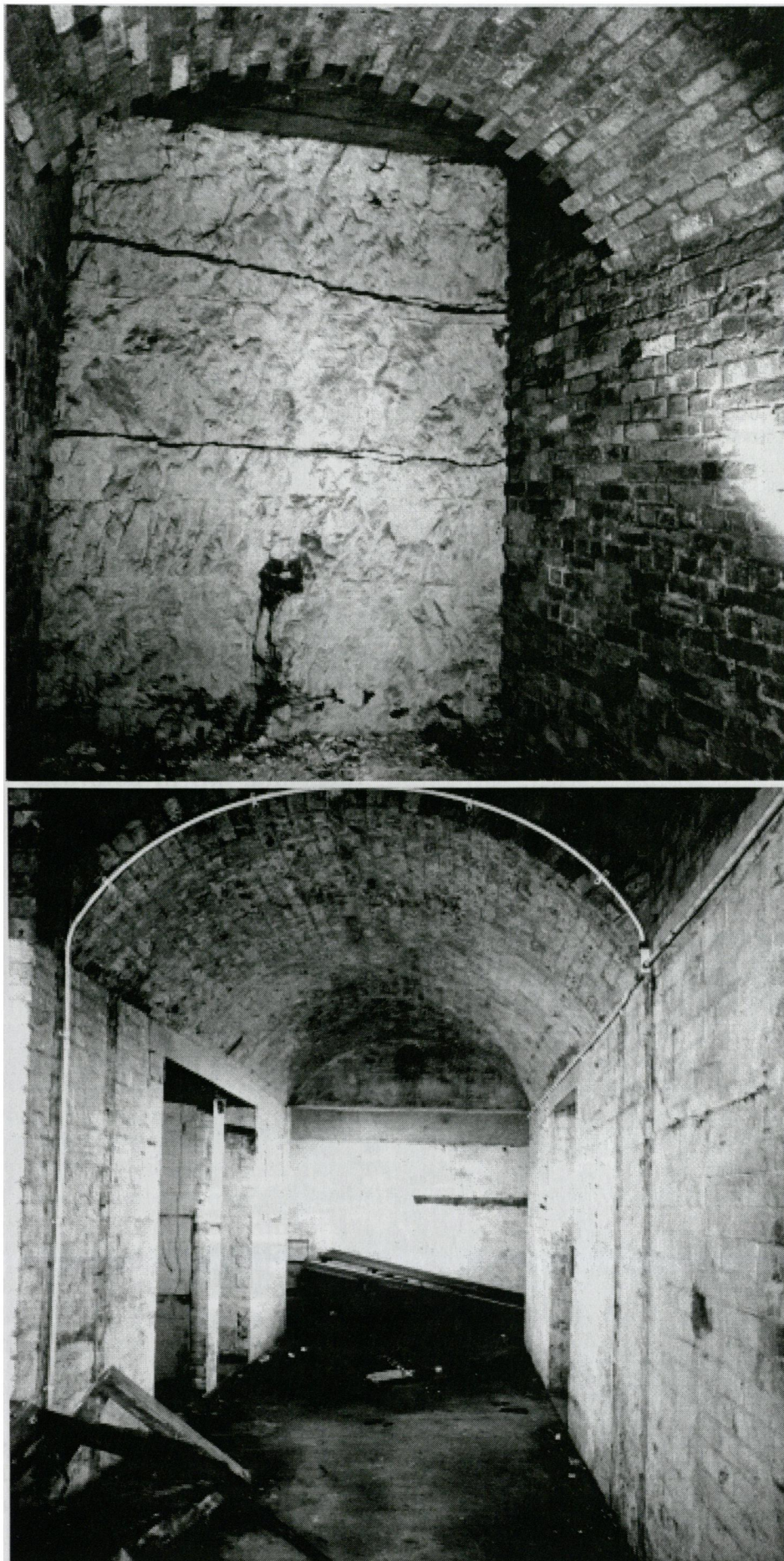
Centre gallery - ventilation chamber ...

with a machine bed, and ventilation shaft 'cut in chalk and unlined, with terminal cowl (rusted and deteriorated) at upper end.'

Bay off north side - Warden's office

Presumably the authors, Craig Hall & Co (who were chartered surveyors, of 39 Lombard Street, London), reported on the derelict shelter, as abandoned after World War II, on behalf of Cox, Hargreaves and Thomson Ltd., as potential occupiers.

A little more light is thrown on Cox, Hargreaves and Thomson Limited by UK



Two views inside the Coulsdon deep air-raid shelter
Nick Catford



Two views inside the Coulsdon deep air-raid shelter
Nick Catford

Patent 852,302 (originally filed 4 May 1959, and complete specification published 26 October 1960.) The patent was filed jointly by the company and by Frederick James Hargreaves, resident at Mirastelle, Woodland Way, Kingswood (Surrey.) The specification itself is concerned solely with the technicalities of 'variable-focal-length objective systems' and tells us nothing about the underground works.

THE NEARBY CHIPSTEAD VALLEY and KENLEY (RIDDLEDOWN) SHELTERS

Roger Morgan (1982) has published some information on deep public air-raid shelters from a then recently declassified Home Office file in the Public Record Office (PRO HO 205/321) which lists numerous deep public air-raid shelters throughout the country, both newly-built and created by the conversion of pre-existing underground space. This indicates that there are, or were, two other such structures excavated in the immediate neighbourhood of the Coulsdon shelter - one at 'Purley Riddlesdown chalk pit', and another at 'Chipstead Valley', although this was abandoned before completion.

A further Home Office file (PRO HO 205/352) indicates that the deep 'new work' shelters had been commenced, without central Government authority, by the Surrey County Council, with a view to accommodating the majority of the county's population if needs be. Five 'new work' deep shelters excavated in chalk, including two at Epsom, were visited on 8 April 1941, and found to be in course of construction. This file identifies the Chipstead Valley shelter as 'Banstead Wood'; notes that it was 'abandoned' after 272 feet; and that there was a car park and playing fields at the entrance. There were two shafts, a vent, and two spoil heaps.

A third file (PRO 206/14) contains sketch-plans of all five deep shelters excavated as 'new work' in the chalk of east Surrey, including the two at Epsom. These were inspected on 15 August 1941, and the

soundness of the shelter roofs was assessed. The Chipstead Valley shelter roof was rated as 'C' (bad) throughout. The Home Office documents tell us that the structure was to have accommodated 5,200 bunks, and at the time of abandonment (presumably) had cost £ 88,000. Presumably it was abandoned soon afterwards.

The exact location of the abandoned shelter has yet to be determined. Given the still semi-rural nature of the area, it seems probable that this too would have been sited for convenient access by public transport. Somewhere near Chipstead railway station (TQ 276582) seems the most likely. Enquiries locally (Sharp, 1983; Sowan, 1982, 1983, 1984) and visits to Chipstead Valley by both of us suggest the abandoned shelter was at approximately TQ 272579, on the west side of Outwood Lane (the B2032.) This is about 700 metres from Chipstead railway station, and about three and a half kilometres from Lion Green, on the Brighton Road at Coulsdon.

Harry Pearman (1963) has described the shelter at Riddlesdown (otherwise Kenley) (NGR TQ 325603) as it was when in an abandoned state during the 1950s, and provided a plan. It has subsequently been in use by Optical Surfaces Ltd, in connection with the manufacture of optical instruments. The Kenley shelter is, again, beside a main road leading southwards from Croydon (the A22.) There are bus stops and a railway station nearby. At this site the ground rises more steeply, towards the east. The three main tunnels here are longer (about 90 metres), and run into the hillside from the face of a pre-existing small chalk pit on the east side of the road. There are six lateral tunnels, at right-angles to the main tunnels, each about 76 metres long. Ventilation was via two higher-level tunnels above the main level, and these open to the exterior higher up the chalk pit face. Pearman noted that there had been some post-war use, briefly, for mushroom cultivation. The current occupiers have been there for at least 20 years (Croydon Advertiser, 17 November 1975.)

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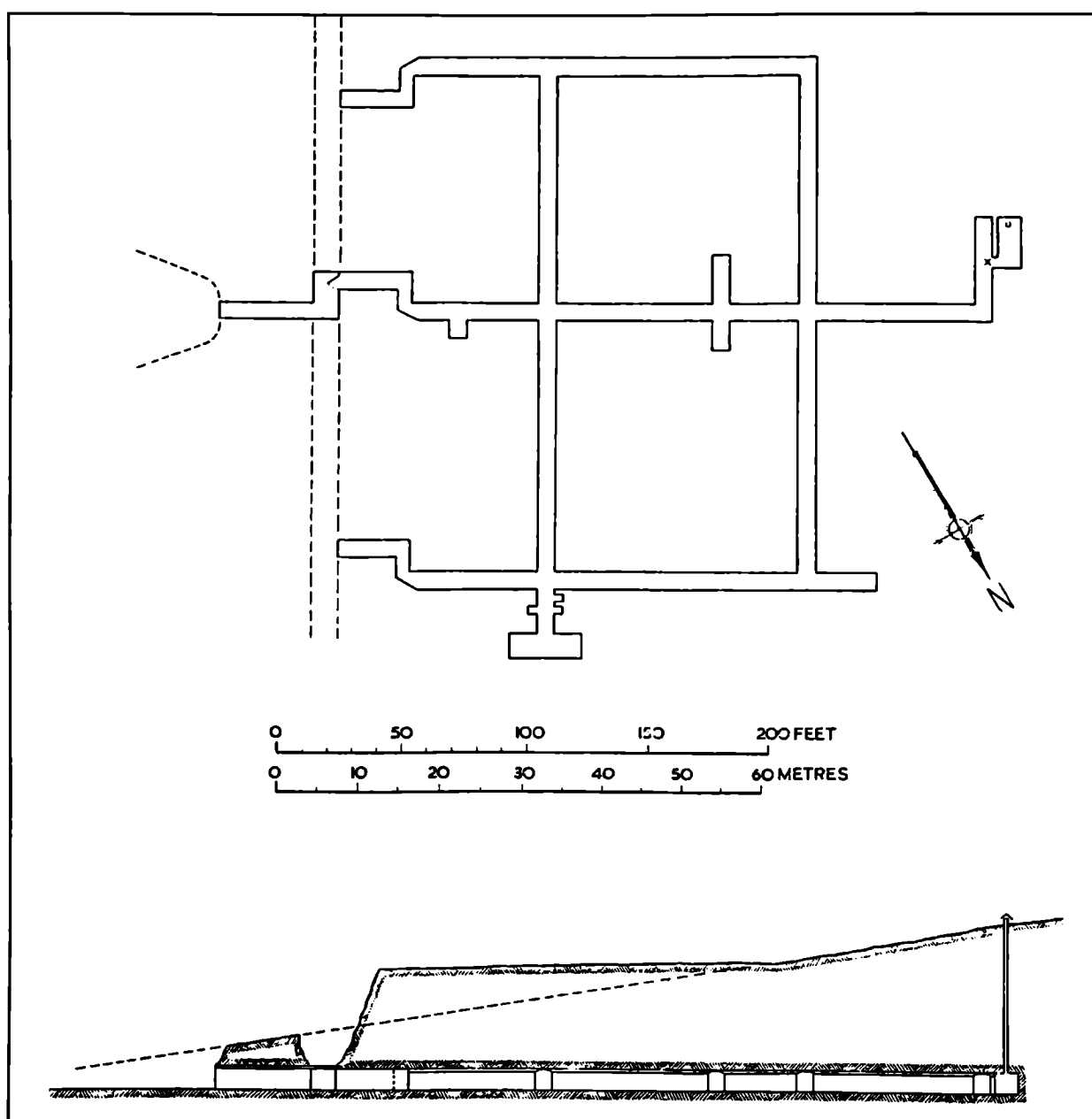
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Plan and section of the deep air-raid shelter at Coulsdon, Surrey
Cox, Hargreaves & Thomson

JOHN WILLIAMS and METROPOLITAN SUBWAYS

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ABSTRACT: Subways, to take services below the streets, have long been a subject of study for those interested in underground space in urban contexts. An often-quoted source is John Williams' *An historical account of subways in the Metropolis*, published (1) in 1828. This paper is the result of an attempt to find out more about him, and specifically his proposals for London.

KEYWORDS: England / London / subways / urban / tunnels / utilities / gas / water / electricity

JOHN WILLIAMS' EARLY PATENTS

Most of what is known of John Williams is gleaned from his own writing. The very commonness of his name makes him difficult to research. He said he was a 'patentee of account books.' This patent might have been the one taken out in 1799 (2) 'for binding books' by John and Joseph Williams of Holywell Street, St. Clement Danes. They were music publishers, and perhaps he was one of the family. By 1802 his stationery business was at 20 Cornhill, London.

In 1802 a John Williams, then of Portsmouth, took out a patent (3) for 'disengaging horses from carriages safely.' Later, from Cornhill, he patented ways of 'preserving the equilibrium' (4), 'covering' (5), and 'making carriages stable and commodious' (6), thus evincing an early interest in road safety.

JOHN WILLIAMS AND THE EARLIEST GAS COMPANIES

Before 1811 Williams became one of an elite group of supporters of the first-ever gas company. The use of flammable gas for lighting had evolved towards the end of the eighteenth century. The idea of a centralised public supply gas factory emerged in London via a very eccentric German, Frederick Albert Winsor, who, in 1804, promoted 'The new Patriotic Imperial and National Patent Company for establishing sundry manufactories to make ... inflammable air ... to the purposes of lighting ...' (7.) He gathered up a group of promoters, of whom John

Williams was one. These first subscribers were 'Gentlemen of great respectability and science' (8), including members of the aristocracy and elite business classes. This raises a problem: as we will see there is no indication that Williams was ever particularly wealthy and it is likely that he was, at least, under thirty at this time. Does this mean that Winsor's list of promoters was not all that it was made out to be?

Williams later claimed his influence in ensuring that, from the earliest trials of gas lighting, the pipework went underground where possible; and he complained when the local authorities insisted that pipes, laid for demonstration purposes, were removed. We have only his word for this.

The first public gas works was set up in 1812 (9.) Williams seems to have had very little more to do with it, although he supplied their first set of minute books (his makers' marks can be found inside the volumes in the North Thames Gas collection in the Greater London Record Office (10.)) The last that is heard of Williams in connection with the early gas industry was when, in 1822, he had his own gas supply disconnected. By that date other gas companies had been set up, and were squabbling over areas of supply. Williams signed up to buy gas from a rival, the City of London Gas Company, and caused a minor furore in the process (11.) In that year, Williams' mind was elsewhere. In 1817 he had written to Michael Angelo Taylor, a Member of Parliament with a known interest in street improvements. Williams asked him for help in lobbying

to achieve the subject of his latest patent, 'A method to prevent the frequent removal of the pavement and carriage paths.'

UNDER-STREET SUBWAYS

Thus were his ideas for street subways initiated, apparently springing from his experiences in the early gas industry. The patent embodied ideas from which he never really deviated - understreet passages, connected to houses (12.) He proposed a line for his first subway which was very close to that eventually followed by the District Railway.

Initially he promoted this scheme by calling a public meeting. Although this was 'by no means numerously attended', it brought the subject into the public eye. Later a committee was set up to continue the promotion and included a young architect, Henry Willey Reveley, son of a more famous father. Willey produced drawings of the proposed subways, before leaving to continue his career in South Africa (13.) Reveley, senior, was an architect, who edited volume III of Stuart's *Antiquities of Athens* (1794), and died in 1794 (according to the *Dictionary of National Biography*.) Williams attracted a number of interested parties to his meetings; there was always someone who reminded him that subways were first done in ancient Rome, as well as well-known eccentrics like Baron Berenger (14.)

The Committee issued a prospectus for a London Subway Company. They petitioned Parliament, and busied themselves by writing to the water and gas companies to ask for support, receiving no replies. They seem to have received some support from interests in the City of London and for a while a City Alderman chaired their meetings. They were delighted when a Parliamentary Committee was appointed to look into the management of the various Sewer Commissions. However this Committee's report did not examine subways at all.

Williams petitioned Parliament again, but this petition was mislaid. He began to protest, but was persuaded by the City

Remembrancer that Parliament must not be inconvenienced. It seemed that the authorities really did not intend to take an interest. He began to petition against the Acts of Parliament which enabled newly formed gas companies to open the pavements. However, he did not attend these Parliamentary Enquiries and his petitions seem never to have been heard.

After two years Williams was tired and feeling the strain of the cost and time to his family. He decided to auction his patent at Garraway's Coffee House - the results of the sale are not known. Four years later (1828) his book on subways was published. He attributed the scheme's failure to competition from the many contemporary, and often fraudulent, speculative 'bubbles.'

For the next 16 years nothing was heard of Williams and his subways. His stationery business must have done well and by 1846 he had moved to a 'patent ledger warehouse' in Bucklersbury. He seems to have retired and was living in Ramsgate, Lewisham, or, perhaps Devonport.

By the 1840s other, and ultimately more successful campaigns for underground services were in progress. Williams began to lobby again. He was to write two more books (15), adding to the list of uses to which 'sub-arches' could be put. They would ensure, for instance, that water could be kept clean, malaria would cease, the water supply would not freeze. Railways could be carried through the subways, clean, propelled by 'tracktion' and free because they would be subsidised by the rents of associated shops. There would be a cattle station at Smithfield, also underground, as well as space for the telegraph. Williams wrote busily to the national press explaining his system. It is not clear if any of his letters were ever published. Something very similar to all this was being put forward, and even implemented, by others. There is no evidence that any of these, more successful, promoters had ever heard of Williams.

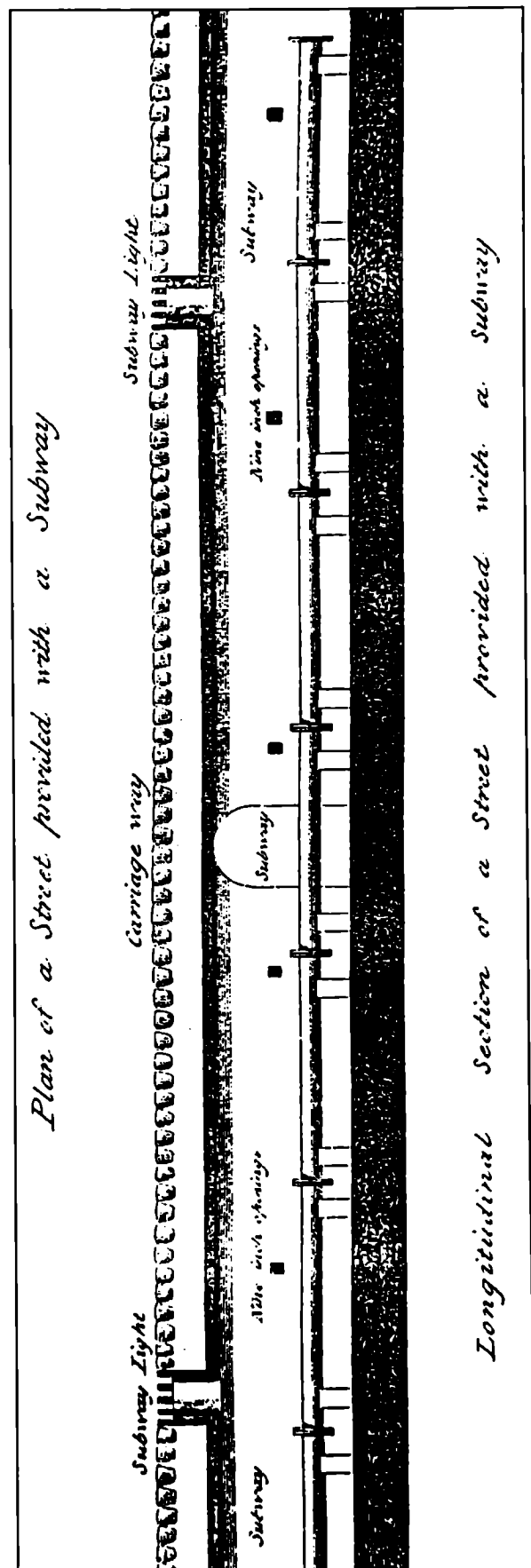
One of the members of the new Metropolitan Board of Works was Alexander Wright, a distinguished consultant gas engineer. In 1857 he proposed that the Board give a prize to the best scheme for subways. The competition duly took place and Williams wrote to the Board to claim subways as his invention and asking for recognition. The Board merely noted that he had no claims on them (16.)

By 1857 Williams must have been an old man. Census and directory evidence from the towns to which he seems to have retired have thrown up no conclusive identification. A will cannot be traced. Perhaps he was the John Williams, living on stocks and shares, in Lee Park, Lewisham, in 1851, with his wife and son; or, perhaps he was the John Williams whose private income was supplemented by his wife's paying holiday guests in Ramsgate (17.) In either case, he had clearly declined from the days when he was a 'Gentleman of respectability' who had promoted the first gas company.

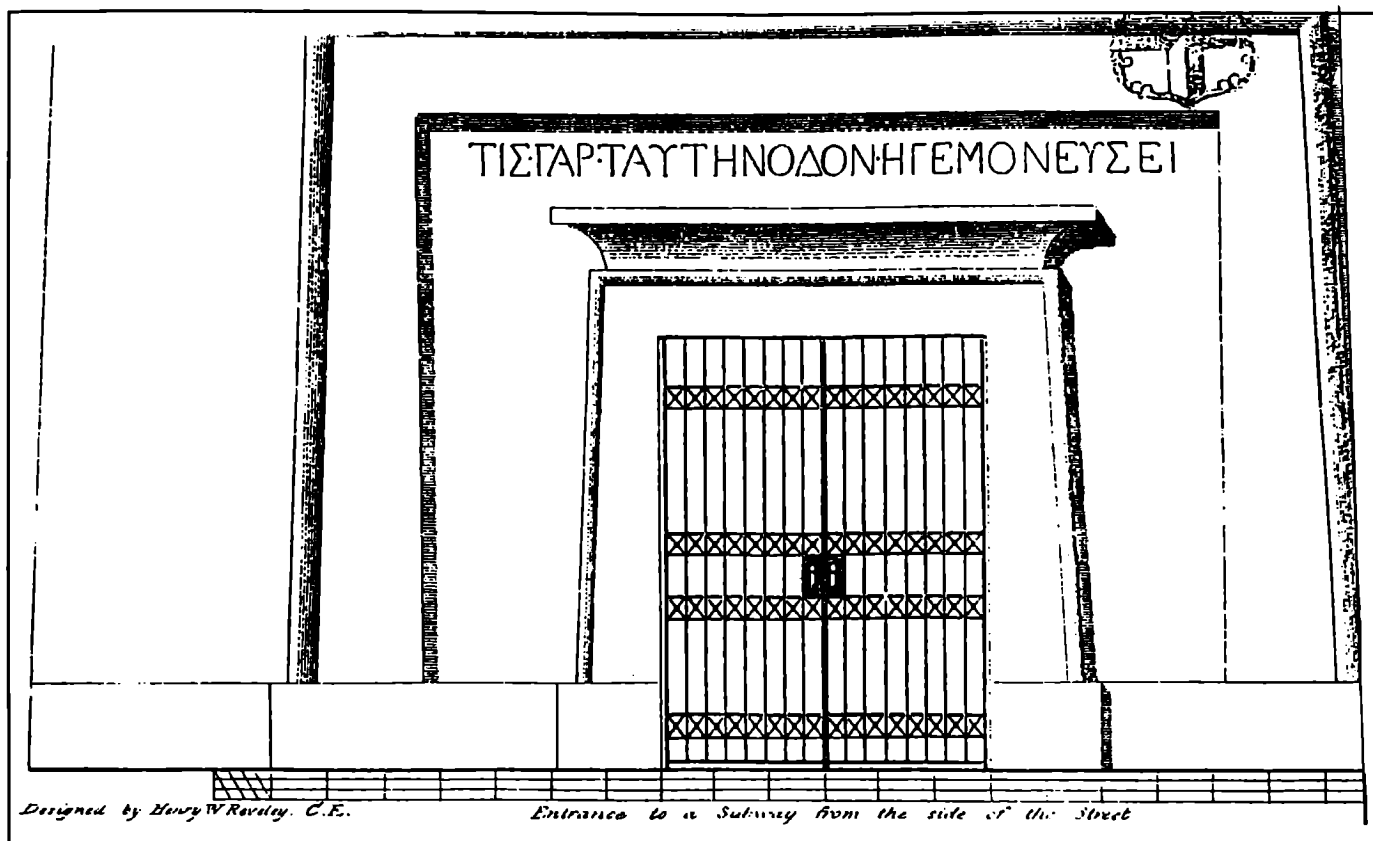
Perhaps as a footnote it should be said that Alexander Wright, promoter of subways on the Board of Works, died with two of his children of cholera, in 1859 (18.) Would an earlier implementation of subways have saved him?

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- (8) *Ibid*



Longitudinal section of proposed metropolitan subway
From John Williams' 'An historical account of subways in the Metropolis'



Portal of proposed metropolitan subway
 From John Williams' 'An historical account of subways in the Metropolis

(9) Most histories of the early gas industry describe this; in particular, see Sterling EVERARD, 1949, *The history of the Gas Light & Coke Company 1812 - 1949*, London: Benn Bros.

(10) North Thames Gas Collection, Greater London Record Office.

(11) Directors' Minutes, Gas Light and Coke Co. (Greater London Record Office), and City of London Gas Co. (Guildhall Library), 1822.

(12) Details of this, and connected events, were described by Williams in his *Historical account of subways ...*

(13) *Dictionary of National Biography* (entry for Reveley senior)

(14) For Berenger see any one of the many biographies of Admiral Thomas Cochrane: Berenger was 'the man in the white cockade.' Some amusing details of his later life can be found in Gillian Tindall, 1977, *The fields beneath*, Temple Smith.

(15) WILLIAMS, John, 1854, *Metropolitan subarches railway. An entirely new system*; and, 1844, *Sub railways in London*.

(16) Metropolitan Board of Works, minutes 1857 - 58.

(17) 1851 Census.

(18) *Journal of Gas Lighting*, 2 August 1859

HOLY WELLS and HERMITS' CAVES in the TEME VALLEY, WORCESTERSHIRE

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Abstract: Artificial caves in calcareous tufa in Worcestershire and their possible uses are discussed, as is the former use of the tufa as a building stone.

Keywords: England / Worcestershire / holy wells / hermits' caves / hermitages / building stones / tufa / travertine

The valley of the river Teme lies in an area of outstanding landscape in Shropshire, Worcestershire, and Herefordshire. The Teme is interesting in that, during the latest Ice Ages, glaciation resulted in the flow being reversed; it now runs into the Severn at Worcester. Between Tenbury Wells and Worcester the river occupies a deep valley and it is in this region that a number of interesting features occur.

The southern slopes of the valley are noted for a prolific spring-line, the exploitation of which has prompted research into water resourcing, building-stone, and a local feature containing hermits' caves. The spring-line, associated with the *Psammosteus* limestone band, is used locally for various purposes including fish-farming, piped drinking-water, and water bottling (Mitchell, et al., 1961)

A typical spring is located at NGR SO 673675, at an altitude of 100 m above Ordnance Datum, in woodland at Lower House Farm, Eastham on Teme (Richardson, 1930) This source has been exploited certainly since Victorian times, and possibly long before, and is known commercially as the 'Aquarius' spring. Excavations in 1990 revealed at least four historic pipelines laid to distribute water, and the issue has been used for many years as a piped domestic supply to numerous cottages in the village of Eastham. Eastham Grange, formerly 'The Spout', was the site of the original manor of Bastwood [? or Eastwood.] The Aquarius spring, it is believed, was the principal water supply for the manor. The old, now abandoned, facilities provide an interesting archaeological record of

Victorian water engineering on a small scale, incorporating carbon filtration and collection chambers. New facilities, installed in 1990, have enabled a small water packing enterprise to be established at the farm. Mr. Ward, the farmer, is always pleased to meet anyone with a serious interest.

Not only do the springs provide a supply of high quality water, they also provide a local, prestigious building-stone. Some of the springs issuing from the *Psammosteus* limestone are heavily charged with calcareous material which is deposited as tufa. In many instances this forms a coating on the underlying rocks of the stream section, occasionally producing a curtain at waterfalls. Substantial amounts of the tufa have been deposited in places in the Teme valley, especially at Southstone Rock, just north-west of Shelsley Wash, NGR SO 708639. A cliff over 50 ft high has been formed, complete with caves, and is reputed to be an ancient hermitage.

The reverend Lees (Lees, 1856) gave a detailed account of the 'hermitage' in 1856. Anciently, a series of rooms and passages had been mined in the Southstone Rock. By the mid-19th century much of the original structure had collapsed although its fuller extent was still within living memory when Lees wrote. Two monks from the Abbey of Evesham once lived in the hermitage and acted as guardians of the Holy Spring. This was reputed to have healing qualities. These were supplemented by the rare plants growing nearby. These plants were not indigenous to the locality, and were likely the relics of

an early eremitic garden. In the mid-19th century there was a cottage, now gone, on the summit of the rock. There were also the remains of a chapel, reputedly dedicated to St. John (op. cit.)

Access is by public footpath through the woods, and is well worth the effort. During a visit in 1995, traces of more recent habitation of the caves were apparent. The tradition of the hermitage is perhaps being continued to the present day, although I doubt if the occupants are registered for local council tax!

The calcareous tufa from the Southstone rock, and elsewhere, has been used as a building material noted for its free carving properties and lightness. The main use has been in religious structures, for example extensively in St. Andrew's Church at Shelsley Wash. It has also been employed for the vaulting of the transepts in Worcester Cathedral, and in the walls of the nave and chancel in Eastham Church, where it is also known as 'Tarantine stone', quarried locally from Pipers Brook (Anon, 1952.) The deposits at 'Death's Dingle' are the likely source for Eastham Church.

The term 'tufa' is generally applied to soft, fine-grained, porous calcareous rock that accumulates rapidly with the evaporation and cooling of suitably mineralised spring-waters. Travertine is a harder, more compact version formed similarly, and is characterised by bands of contrasting colours resulting from fluctuations in the water mineral content. Travertine can be polished and used ornamentally and for jewellery (Windsor, 1990.) There is no clear boundary between tufas and travertines, and confusion between the terms is understandable. In either case, during accumulation, considerable quantities of leaves, snail-shells, and other materials are incorporated and fossilised within the rock. This ability to 'petrify' such materials has been exploited elsewhere, particularly at 'Mother Shipton's petrifying well' at Knaresborough (Yorkshire), a popular

natural wonder for hundreds of years (it was visited by Celia Fiennes in the course of her 'northern journey' in 1697 (Fiennes.1947).)

James Downs remembers, c. 1965, the Teme valley travertine or 'Colite stone', which was soft when wet, being stacked in blocks, in rows like bricks, on a small patch of land near Astley Bridge. This stone, from Death's Dingle nearby, was dried in this manner for about 12 months before use, and was cut with briar-toothed saws. It was used for repairs to Knighton-on-Teme church (Downes, c. 1965.)

Death's Dingle (NGR SO 670678) is a landscape feature formed by erosion by Pipers Brook, formerly Spout Brook, a tributary of the Teme. The brook originates from springs emerging from the *Psammosteus* limestone which is exposed at many points in the dingle and on the western side is six to seven feet thick. Fine waterfalls result where it rests on the red marl in the stream bed. In many places the underlying geology is masked by the tufa, which occurs both as a substantial solid deposit, and in a loose granular state. Death's Dingle is named after De'Ath who, chasing a wild boar, was gored to death, according to James Downes. An alternative legend is that a rider's horse took fright on the path by the dingle and sent its rider to the bottom of the chasm, with fatal results.

The investigation of the hydrogeology of the springs shows that the area around the Teme valley is formed by sediments of the Old Red Sandstone series. The geological succession is shown below:

FORMATION [OLD RED SANDSTONE}	APPROX. THICKNESS [[METRES]
Brownstones	300
Ditton Series	550
<i>Psammosteus</i> Limestone	1 - 4
Downton Series	500

It is in the limestone bed, outcropping on the southern valley sides, that a number of springs occur along the Teme valley escarpment. The limestone forms a persistent band. Beneath the spring-line which it forms, some 60 - 90 metres of red marl, containing occasional sandstone bands, forms the relatively impermeable upper horizon of the Downton Series.

Groundwater flow in the area is as a result of the primary and secondary permeability of the strata. Primary permeability of the limestone and much of the sandstone is low as a result of their fine-grained and cemented nature. It is considered that fracturing and jointing (secondary permeability) permits the most significant groundwater flow, particularly in the limestone.

The area is certainly worth exploring, not only for its springs but also for its outstanding beauty. The nearby town of Tenbury Wells was once noted as a spa, and a ruined ornamental pump house still survives. The local museum houses an interesting collection of artefacts worthy of greater attention.

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From the literature ...

PEDEN'S CAVE at SANQUHAR

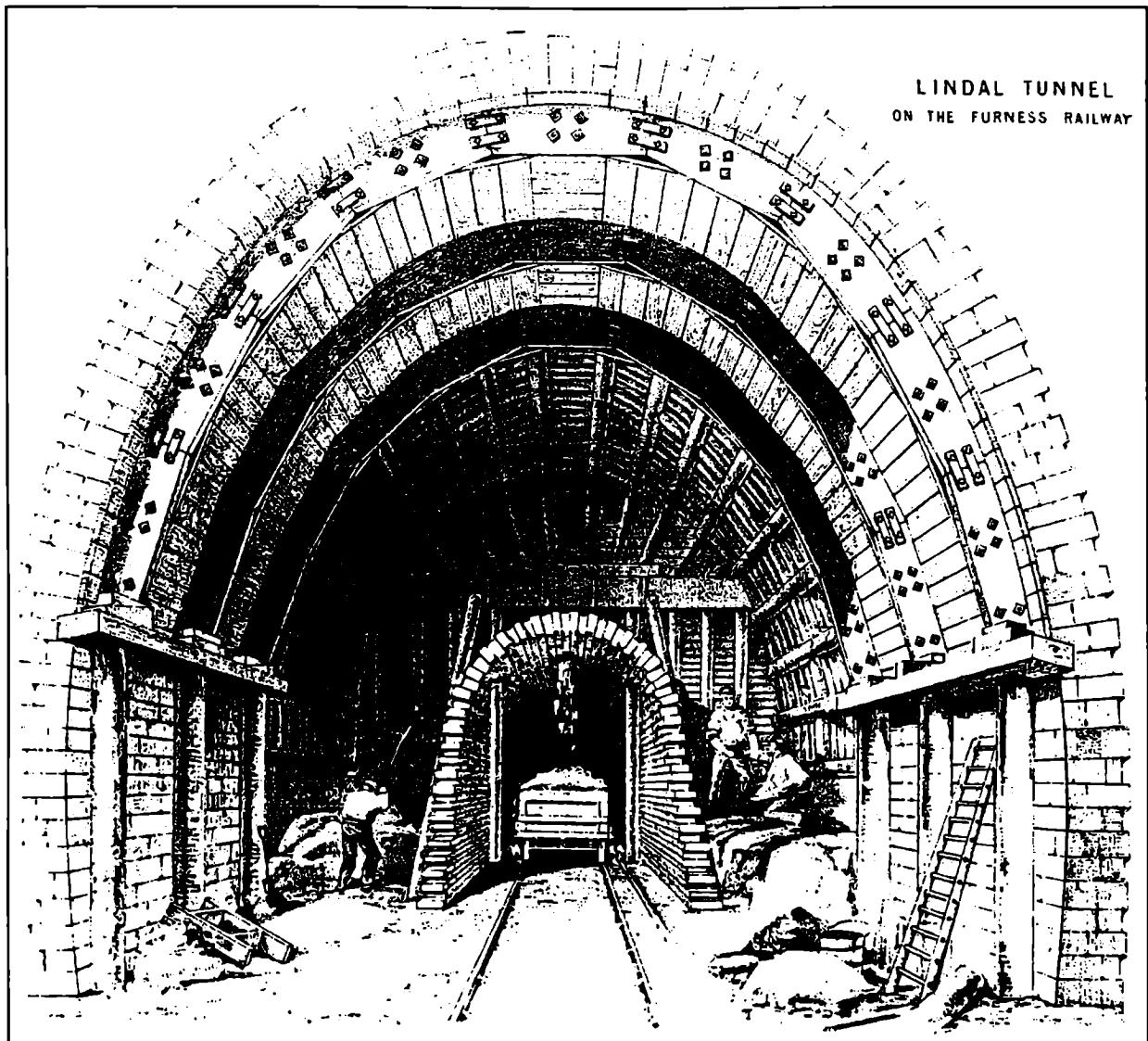
From our station on the Sanquhar town common, we have again on the east of the general table land of which it forms a part, a full view of the grey height of Auchingrouth, celebrated as the spot where the venerable Peden was secluded from his pursuers by the mist which so seasonably enveloped him and the few friends that were with him, wandering in the moors in the dark and lowering day of the church's affliction in Scotland. The cave which this worthy had as his retreat among the thickets at the mouth of the Glendyne, was long after pointed out by the shepherds, who knew the very spot. A spear, old and rusty, was lately found in it, supposed to be a relic of those times, and probably belonged to some of the persons who made this cavern a hiding-place. Glendyne is one of those deep defiles

that run far back among the hills, cleaving almost to their very foundations the entire mass of mountains that encumber the eastern parts of the parish of Sanquhar. This magnificent glen terminates with a majestic sweep on the vale beneath. No one gorge in the southward parts is to be compared to this for the steepness of its hills and narrowness of its glen.

SIMPSON, Robert, 1865, *History of Sanquhar. A new edition*, Glasgow: Thomas Murray and Son, pages 13 - 14.

EDITORIAL NOTE ...

Sanquhar is a parish and large village at NS 7809 in Dumfriesshire, on the road from Dumfries to Ayr.



Lindal tunnel on the Furness Railway, in course of enlargement from single-track to double-track
 From D. Kinnear Clark and F.W. Simms, 'Practical tunnelling' 3^d edn.

From the archives ...

ENLARGEMENT of the LINDAL TUNNEL, on the FURNESS RAILWAY

Abstract: The following account and illustration is reprinted from Frederick Walter Simms' and D. Kinnear Clark's *Practical tunnelling, Third edition*, of 1877. It is offered as a specimen of unusually detailed technical writing for its period, which the modern reader (with the assistance of the illustration) is invited to follow; and, more importantly, throws light on an extraordinary tunnel-widening exercise. Subheadings, not being part of the original text, have been inserted by the editor to assist the reader.

Keywords: England / Lancashire / railway tunnels / tunnel-widening

MESSRS. FELL & JOPLING'S CONTRACT for a DOUBLE-TRACK TUNNEL, and SUBSEQUENT COMPLETION as a SINGLE- TRACK TUNNEL

The first contract entered into, was made for a tunnel, with a double line of way, with Messrs. Fell & Jopling, in June 1847; but it was annulled, after the works had been in progress for five months, in consequence of the monetary crisis of that period. If the contract had been completed, the tunnel would have cost -

In rock, per lineal yard ... £ 21 0s 6d

In masonry, per lineal yard ... £ 45 0s 0d

After a suspension of about a year, a fresh contract was entered into for a tunnel of a single line, which was executed, completed, and opened in June 1851. The tunnel was about three-eighths of a mile in length, and it passed through material consisting of limestone rock, pinule, loose gravel, and clay with loose boulders; and the foundations throughout were good. When lined, it was 14 feet 6 inches high, and 12 feet wide; and it cost as follows -

In rock, per lineal yard ... £ 6 0s 0d

In masonry, per lineal yard ... £ 15 10s 0d

DECISION to WIDEN THE SINGLE-TRACK TUNNEL of 1851 to DOUBLE-TRACK in 1854

In consequence of the increase of traffic, it was decided, in 1854, either to enlarge or open-cut the tunnel. The plan

of open-cutting was entertained, in case it might be necessary to ensure the regular working of the traffic during the progress of the works; but the additional cost of open-cutting over that of simply enlarging the tunnel was estimated at 12,000 l., and from the tenders received it appeared that it would have cost more than twice as much. It was determined to enlarge the tunnel, and the tender of Mr. William Tredwell was accepted. The contractors who tendered generally preferred or proposed to construct a supplemental tunnel rather than be subjected to the interruptions that must of necessity be caused by the trains during the operation. Mr Tredwell offered to construct another single tunnel, with the necessary additional excavation, for the same sum; but this proposition was not favourably entertained. There was no precedent for a work of this kind; and there were disadvantages, besides, in working single tunnels - the difficulty of properly lifting and packing the permanent way by reason of the stifling atmosphere that is raised after the passage of heavy trains, which prevents platelayers from working for any great length of time together; and the condensation of steam upon the rails - all of which increases the expense of working. Besides, the tunnel was on a gradient of 1 in 100.

It will be seen from the illustration [Plate XVII in the original] that the tunnel was to be increased in width equally on each side, the level of the rails remaining the same. It was proposed that there should be two shafts, one on each side of the existing tunnel, so that the mining

operations could be proceeded with, and the materials be removed, without interfering with the shell of the small tunnel. This, it was intended, should act as a protection to passing trains until some lengths of the large tunnel had been completed. In consequence of these conditions, the section of the proposed tunnel was considerably in excess of what has usually been allowed for two lines of railway.

WIDENING COMMENCES in 1855

The works for the enlargement of the tunnel were commenced in June 1855, at the old shaft No. 3, which was widened, instead of two new shafts being sunk, as at first contemplated. The line was given up to the contractor for eight hours a day, during the night. The shaft was divided down the centre by a strong timber brattice, so that it could be worked as two separate shafts. Top headings were driven, for short distances, at the proper levels, above the existing tunnel. The material was found to consist of dry, hard clay and gravel; but it was observed, both in widening the shaft and in driving the headings, that the ground had become set and broken up, from mining operations, to a much greater extent than could have been anticipated. As it was probable that such might be the case, more or less, throughout, and as it would, when wet, render the ground very treacherous, it was thought advisable to make the tunnel for the double line of less dimensions than at first intended. The crown was kept sufficiently high to allow the mining operations, in getting out the roof, to proceed, without interfering with the original tunnel. Wrought-iron centering was employed where necessary; also a shield to support the masonry of the small tunnel whilst a length was being excavated above, which served, besides, as a protection to the railway. The roof of the first length was executed by placing the sills for the support of the bars three feet above the crown of the small tunnel, on which and on the material forming the sides of the tunnel, they rested. A portion of the masonry of the small tunnel was

then removed, and the excavation for the side walls was proceeded with. Working by shafts was afterwards dispensed with, as the alteration in the size of the tunnel did not permit of the excavation for the side walls being taken out before the masonry of the smaller tunnel was removed.

CREATING ADDITIONAL WORKING FACES

In order to obtain another face to work at, it was necessary to break through the original tunnel, which, in fact, was used as a bottom heading. The operation was commenced by drilling through the soffit of the arch, to ascertain the nature of the material above. If satisfactory, a manhole was made, and the earth was removed, by means of a bar, until the excavation was sufficiently large to admit a miner. The hole was then timbered all round, leaving the top open. Another length of a few feet upwards was excavated, and timbered in a similar way; the process being repeated until the level of the top heading was reached. From this upright shaft the headings were driven, and the ordinary method of tunnelling was adopted. After a few lengths were completed, a regular system of timbering and of working was instituted, little distinction being made between light and heavy lengths. The bars used were chiefly of larch, varying in size from 15 to 18 and 22 inches in diameter; they were placed from 12 to 15 inches apart round the roof, and supported at each end by props from the sills, which were of pitchpine, from 20 to 22 inches square. A saddle, or half-balk, was placed on the top of the sills, and fastened to them with wrought-iron glands. The sills were supported from the ground by two upright props passed through the haunches of the small arch down to the formation-level of the tunnel, by which means only a small portion of the weight of the roof was thrown upon the small tunnel. After the excavation of the upper portion down to the level of the sills had been completed, the arch of the old tunnel was taken down, the side walls removed, and the excavation at the sides proceeded with. A portion of

the small tunnel, from two to three feet in length, was always left in front of the sill, to prevent any materials falling on the railway. The sill was then further stayed by raking-struts from the formation level. Small sills were placed about halfway down the side walls, to carry the props supporting the ends of the first sill, and these again were propped up from the foundations as the material was removed. A second or back upper sill was sometimes placed, to assist in carrying the crown bars; it was either propped from the bottom or from the smaller sills at the sides.

A framing, called by the miners a 'horse-head', was also frequently used. It consisted of two balks, or bars, placed upright, with a cross piece or cap at the top, of sufficient length to take the drawing bars, usually seven in number. This, when well packed up to the bars, greatly relieved the sills. When the ground was more than ordinarily heavy, the lengths of excavation were reduced from 15 feet to 12 feet, 9 feet, or even 7 feet. In some instances it was necessary, after the roof had been timbered, to put in additional bars, called lining bars, with those already placed. These were propped from the sill, or were carried by horse-heads. When well packed with other timbers, they formed a nearly solid timber roofing, 14 to 18 inches thick, for 12 or 14 feet round, exclusive of the poling-boards between the material excavated and the bars.

GROUND SETTLEMENT

Four years had elapsed between the completion of the small tunnel and the commencement of the enlargement. This was considered sufficient time for all settlements and runs, from previous mining operations, to have become consolidated. But the displacement of the roof had been very great, and, from the nature of the material, the water appeared to have been impounded in the settlements, forming small reservoirs. One of these was met with near shaft No. 4, the two faces then being 90 feet apart. In one heading, the materials, which were very wet, consisted of clay, gravel, and

large stones, and soon became converted into mud, which oozed through the timbers, filling up the heading and displacing the framing. After a large quantity of mud had been removed, the run subsided, and the excavation became more consolidated; then a continuous dropping was heard in advance of the work, giving signs of a cavity, whence, no doubt, the mud had issued. On widening out the boundary, a large hole was discovered, the top of which was 70 feet above the rails and 28 feet below the natural surface of the ground. It was supposed that the cavity was a natural reservoir, supplying distant springs, and that a vein of clear gravel and sand, which was cut through, had acted as a conduit. The mouth of the hole was timbered, and, as far as possible, the entire place was filled up. The vein of gravel, from the first, showed symptoms of running; and when the length was widened out, cutting the vein across its full extent, the length fell in, causing a cessation of the traffic. The works were soon reinstated, fresh lengths were put in, and the work was completed beyond the shaft and the cavity without further accident.

MASONRY

The masonry, both for the side walls and for the arch, was of fitted lime-stone rubble, from 2 to 3 feet in thickness, set in Abershaw lime-mortar. The stone was obtained from the adjoining cuttings. A length of tunnel of 15 feet was excavated, on the average, by eighteen working sets or shifts of eight hours, representing one day's work of 60 miners and 75 labourers, but some lengths occupied as much as thirty-three working sets, or one day's work of 103 miners and 120 labourers. Of this number, eight sets were generally employed in getting in the crown bars. The amount of excavation in each length was about 300 cubic yards.

The time occupied in building the side walls of a length of 15 feet averaged two sets, and in building and keying the arch, eight sets; employing in all 32 masons and 40 labourers, one day each. The time of the masons and labourers was scarcely

found to vary; any additional time was easily accounted for by the difficulty in setting the masonry amongst the extra timbering used in heavy lengths. The ribs or centres were set by a leading miner and some labourers; it occupied about two sets, employing two miners and ten labourers one day.

COMPLETION of the WIDENED TUNNEL in 1856

The whole of the work was completed in about seventeen months, from June 1855 to November 1856. The number of trains that passed through the tunnel averaged eighteen trains per day. The length of the complete tunnel was -

In solid limestone rock ... 123 yards

In loose material, lined with limestone rubble masonry ... 337 yards

Total length ... 460 yards

The portion of the tunnel executed in masonry was completed in sixteen months. For the first eight months, four faces only were in progress, when 87 lineal yards were completed, being at the rate of 2 1/2 yards per week, or less than 2 feet per week at each face. The actual time expended in completing each length of 15 feet averaged thirty sets or days. If calculated according to the total time that the works were in course of construction, it would therefore appear that as much time was necessary as an allowance for contingencies, as for the actual execution. Great difficulty was experienced in obtaining workmen and in keeping them regularly at work.

COST of the WORK

The total cost of the tunnel, when completed, was as follows -

In 1849, the contract price for the small tunnel, in rock, per lineal yard ...

£ 6 0s 0d

In 1854, the additional cost, when enlarged ...

£21 4s 0d

Total cost of the double tunnel, in rock, per lineal yard ...

£27 4s 0d

In 1848, the contract price for the small tunnel, lined with sandstone rubble masonry, per lineal yard ...

£15 10s 0d

In 1854, the additional cost of widening ...

£38 0s 0d

Total cost of the double tunnel, lined with fitted limestone rubble masonry ...

£53 10s 0d

The rate of 6 l. per lineal yard, as the cost of the original small tunnel in rock, is equivalent to 6s 2d per cubic yard of solid rock - a fair price when the material is not excessively hard.

EDITORIAL NOTE

According to Popplewell (1985) the Whitehaven & Furness Railway was opened from Whitehaven to Bootle on 1 July 1850, and extended via Lindal to Ulverstone in 1852, John B. Fell having completed the Crooklands - Lindal section by 21 May 1851. The Crooklands - Lindal doubling contract was let to John and William Tredwell in July 1855, the work being completed in May 1857.

The Lindal tunnel (439 yards, or about 405 metres) lies at NGR SC 2475 between Dalton and Ulverstone stations on the railway some seven kilometres to the north-east of Barrow-in-Furness. The line, the tunnels, and the stations continue in use in 1997.

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From the literature ...

A VISIT TO THE TUNNELS AT SHAKESPEARE CLIFF, NEAR DOVER, KENT

In the formation of a tunnel through the side of a hill, considerable expense has sometimes been saved by the construction of horizontal galleries from the face of the hill to the side of the tunnel, and by removing the excavated earth through them. The double tunnel through Shakespeare's Cliff, near Dover, on the South Eastern Railway, was constructed in this manner. Seven vertical shafts from the top of the hill were first sunk, and seven horizontal galleries were then made from the face of the cliff which united with "the verticals;" and the two tunnels were then excavated parallel to the sea, from which they run at a distance of four or five hundred feet. A road was previously formed along the front of the cliff to afford means of access for the workmen. The galleries were each about six feet wide, and seven high; and the excavated chalk was conveyed along them in small tram-wagons, and tipped into the ocean below.

During the construction of the tunnel, the company courteously permitted the public to visit the scene of operations, and the spectacle was unique and impressive. On entering the bore, a lantern was furnished to the visitor, who was allowed to venture as far within as his courage, or his lack of it, directed. A slight glimmering of daylight tempted some onwards, but it was insufficient to dispel the darkness which seemed but to be rendered "more visible" by the lantern. On reaching the first shaft daylight was again enjoyed, while the aperture overhead extended to a height nearly equal to that of the Monument of London; seven times did this recurrence of the sun's beams break on the gloom of the long cavern; while those whose

perseverance and energy were not exhausted, might witness the extensive preparations at the other end, then making, for continuing the line along the base of the cliffs near the sea-shore of Folkestone.

WILLIAMS, Frederick S., 1852, *Our iron roads: their history, construction, and social influences*, London: Ingram, Cooke, and Co., page 146.

Editorial note ...

The twin tunnels, on what was the original main line from London to Dover, via Folkestone, continue in use. The roadway around the face of the cliff has long since been eroded away, but at least one of the seven driftways was both visible and accessible from the beach in recent years, neither the seaward end nor the inner end being sealed in any way. The driftways are too low in the running tunnel walls to be visible to passengers in trains to Dover passing through the seaward tunnel. The tunnels were made in 1840-44 and are 1,392 yards long.

Persons walking over the top of Shakespeare Cliff (there is a public path from Dover towards Folkestone Warren) will note the tops of the seven shafts mentioned, and will note also the absence of tunnel-spoil tips beside them.

The next tunnel on the line towards Folkestone, the 1 mile 182 yards Abbotscliffe tunnel, is a single bore double-track tunnel, but in other respects was made in the same way as described here, using 13 vertical shafts and an equal number of driftways.

From the literature ...

JET MINING AT WHITBY, YORKSHIRE

As I was walking along the summit of the cliffs on the other bank of the Esk, in a direction southerly, as applied generally to the coast, but in point of fact easterly, more properly speaking, I heard that some men were digging jet a few miles from the town, and therefore proceeded in search of them. I was in the end only partially successful, for I met with the men and I saw the jet, but I did not see them, as I wished, in the act of digging it. I came to the spot where they were at work, but they were at the extremity of a level, driven under the verge of the cliff, so that I had an equal chance of detecting a sea-bird sitting on her eggs, as of discovering these men pecking at the rock within their burrow.

Returning to the town I encountered them on the way, one with a narrow sack of jet on his shoulder, which each took it in turns to carry. They opened the sack and showed me the jet, in pieces the size of ordinary charcoal; they said they were miners by trade; that they rented the ground where they worked on speculation; that the tradesmen in Whitby gave them a fair price for all the jet they could furnish, and manufactured it into ladies' ornaments; that the price varied considerably – from 3s. 6d. to 10s. per stone.

The jet is found among the cliffs in very narrow seams, not more than two or three inches deep; consequently the work is performed in extremely narrow space; almost in a recumbent posture, and the rubble and earth dragged outwards on the

hands and knees, by a rope round the middle, after the manner adopted by the colliers in the narrow seams of coal. It frequently happens that the workman is lowered over the edge of the cliff, in order to reach the mouth of the level by which he enters. A man very often not only works alone all day in such a gloomy state of confinement, but reaches his solitary dungeon without assistance, merely by the perilous expedient of a rope rove round a stake fixed in the summit of the cliff: by the rope he lets himself down, and at the end of his day's work pulls himself up again.

At the spot where these men were at work, the cliffs are two hundred and eighty feet high, and form a bight to which sea-birds resort in considerable numbers: though I had probably arrived within a few hundred yards of the place I was seeking, without further information, there was no visible object to direct my search.

As the crow flies, the point in question is not more than three miles and a half from Whitby; by the cliffs the way amounts to about five miles: thus as I sauntered along I occasionally descended to the level of the sea, and walked sometimes, as far as was practicable, along the shore. ...

HEAD, Sir George, 1836, *A home tour through the manufacturing districts of England in the summer of 1835. New edition.* John Murray, pages 287 – 288 [A new edition with an additional introduction by W.H. Chaloner was published by Frank Cass & Co. Ltd. in 1968]

CAVE MUSHROOMS: A NEARLY EXTINCT CULTURE

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ABSTRACT: This paper deals with aspects of the cultivation of mushrooms in abandoned underground limestone quarries either side of the Belgian / Dutch border in the neighbourhood of Maastricht, Zuid-Limburg province, in the Netherlands.

Keywords: Belgium / The Netherlands / Zuid Limburg / building-stone quarries / secondary uses / mushroom culture

INTRODUCTION

The culture of mushrooms (Dutch: *kampernoelies*) in underground quarries in The Netherlands was commenced in the Fluwelengrot at Valkenburg in 1889. Inscriptions in the Zonneberg quarry near Maastricht indicate that one Simons laid down mushroom beds there in 1900. Previously, mushrooms had been grown outdoors as early as 1829 at Haarlem. French mushroom culture appears to date from about 1750.

MUSHROOM-GROWING TERMS

As with all trades, mushroom culture has specialist terms, including:

Green manure: pure horse manure, from horses fed on oats mixed with a little straw. Molasses or grass were not allowed to be fed to the horses. Supplies were obtained from organisations which kept large numbers of horses under carefully controlled conditions - circuses, police, and military stables, for instance. Military stables, with a large horse population, were especially important. The quantities of manure required dictated that supplies were carted-in from as far away as Oostende (Belgium), and Bonn and Köln (Germany.)

Casing: black peaty earth of pH about 7.0 collected from marshy areas. This material was used to form a thin layer over the horse-manure beds. The mushroom mycelium derives nutrients from the manure, but the spore-bearing bodies (mushrooms) grow through the casing.

Mycelium: a mass of fine white fungal threads (also called fungus-flock), which constitutes the main continuing living mass of the plant. The spore-bearing bodies (the actual mushrooms) grow from the mycelium. Spores released from them can develop new mycelium on a suitable substrate. The microscopic spores, collected in special sterile breeding-houses, are mixed with grain, to which they adhere. This material can then readily be 'planted' in freshly prepared manure beds.

Cellar: a distinct part of an underground mushroom farm. Several 'cellars' are needed, divided from each other by (for example) stone walls or (more recently) plastic sheeting to regulate air circulation and to prevent the spread of disease. Different stages of growth take place in different cellars, and all-year-round cropping is possible.

EARLY METHODS

Early mushroom-growing methods were very different from those used today. Green manure was taken into the quarry by horse and cart. Up to 120 tonnes had to be placed in heaps. After about two days, fermentation and increased temperatures were noticeable. Ammonia gas was given off, and 'manure-water' was run off and collected. Temperatures could rise as high as 80° C, which killed off harmful bacteria. After a couple of days the temperature dropped and the mound was turned over. The collected manure-

water from the first fermentation, mixed with some fresh water, was sprinkled onto the new heap, in which the temperature again rose, this time to about 70° C. After another two days, the heaps were turned again. The fully-fermented manure was quite black.

In later times, these processes were carried out outside the quarries. Concrete floors for this purpose are still visible outside the Zonneberg quarry entrance. Fermentation caused the manure to cohere as a mass. Nearby was a 'hackle-mill', a machine with rotating cylinders covered in small hooks or spikes, designed to loosen and aerate the fermented manure.

MUSHROOM BEDS

The floor on which the manure was spread had to be disinfected. Before the advent of modern chemical disinfectants, this was achieved by scraping off the top 5 cm. of the stone floor (a calcarenite, or sandy-textured limestone.) To prevent infection of the disinfected cellar, nobody was allowed in for a three-month period, at the end of which the manure was carefully laid out in long narrow beds. Each quarry had its own pattern for these beds, but they were most commonly 20 cm. wide and 20 cm. high, and rounded on top. The length simply depended on the length of the quarry gallery. Narrow pathways were left between beds for access for harvesting. In some quarries such as Caestert and Ternaaien-Beneden (in the Belgian part of St. Pietersberg, south of Maastricht) some of the old mushroom beds are still visible. At a later date in the Roosburg quarry at Zichen (Belgium) beds 70 cm. wide were used, and in others up to 120 cm. Curious high and wide beds such as used at Folx-les-Caves (Orp-Jaune, Belgium) were never, as far as is known, used in the Maastricht area.

After the beds had been formed, the spore-coated grain was planted in small holes made in the sides of the beds, and covered over. This process is known as 'enting.' [The *Oxford English Dictionary* recognises

the obsolete word 'ent' as meaning a 'scion or graft.', and cites a reference from a Dutch dictionary published in 1648.] The thread-like hyphae (constituting the mycelium) grew throughout the bed. The mycelium turned grey after four weeks: that was the time to cover the beds with a 'casing' formed of a thin layer of stone dust. This dust (Dutch '*mergel*', but better described as sandy-textured limestone rather than the apparently equivalent English term marl) was applied by the 'champignonisten' (mushroom-growers) using wooden spades like the ones used by bakers to remove bread from an oven.

The beds had to 'rest' again for four to five weeks before the first button-mushrooms appeared through the casing. From this point, the mushrooms grew to full size in three days.

HARVESTING

Using the old methods, it took three months to raise the first mushroom crop, known as the 'first flight.' Harvesting took a week. After a further week, a 'second flight' could be gathered. Up to six or seven 'flights' could be taken before the beds had to be removed and replaced. Local farmers cleared out the cellars, as this was a cheap source of manure for them. The whole cycle of operations lasted about seven to eight months.

MODERN METHODS

Modern techniques of mushroom-growing are more 'environmentally friendly' (less smelly!), and less labour-intensive. The green manure is fermented in special factories, and the ammonia gas filtered out. The fermented manure is packed in plastic bags holding 28 kg. each, and these are placed in the quarry at a density of about three to four bags per square metre. The 'enting' is also done at the factory, using appropriate spores for large or small, hard or soft, or brown or white mushrooms. The packs are transported and placed underground by tractor. The quarry floor is 'disinfected' by laying a thin screed of cement three months earlier. For

the first four weeks the packs are watched closely for unwanted fungi or bacteria. If all is well, the manure surface is then covered with a four cm. layer of earth (sometimes mixed with stone dust.) If necessary, the packs are watered after four weeks. It is very important during the first eight weeks to guard against microbial infection from other cellars where packs are stored or where harvesting is going on: a complete crop can easily be lost. The 'champignoniste' takes special precautions such as using sets of equipment specific to each individual cellar, and even changing boots when going from one cellar to another. Infection can be recognised by a growth resembling cob-webs, which precludes the proper development of the mushroom mycelium. Or tuberous growths known as 'moles' may appear, or 'moisture-fungus'. Infection can be caused by maggots found in the straw, and result in small brown pits on the surface of the mushrooms which makes them unsaleable. Buckets, containers, shovels, three-pronged forks, cart and waggon and tractor tyres all have to be carefully disinfected. Ignorant persons underground can cause serious damage by visiting the growing areas, opening doors, and causing changes in the air flows.

Because modern growers have more cellars, growing and harvesting can be done all-year-round: they are not restricted to particular seasons. When conditions are favourable, the mushrooms are harvested when two to four cm. high: these are 'Class A' and are sold in the shops. If allowed to continue growing, they realise lower prices. Weekends and celebration-days are therefore normal working days for mushroom-farmers. Weighing and packing in baskets is nearly always done in the quarry.

The weather outside the quarry can influence the quality of the crop. In thundery weather, the mushrooms tend to burst open and are then called 'galopetten' and are rated 'third class.' Because they are riper they have more taste, and are sold mainly to food-processing factories.

In modern above-ground mushroom-houses the temperature is kept constant at 20° C, and the mushrooms grow faster - from 'button' to full size in as little as a single day. One disadvantage is that these mushrooms contain 20 per cent more water than those grown underground.

Mushrooms have been cultivated in most of the Dutch quarries in South Limburg. Some parts of the St. Pietersberg quarries still have names that date from mushroom-growing days - the 'Mingel', the 'Gamert' and the 'pocket of Francken.' Some of these former underground mushroom farms, such as Apostelgroeve, Roothergroeve, and Koeleboschgroeve are now under the protection of Studiegroep Ondaardse Kalksteengroeven (SOK.)

At Koeleboschgroeve, in Belgium, the last manure was brought into the quarry in December 1958. By that date, there had already been some minor roof-falls. A disastrous collapse in a mushroom-growing area in the Roosenburg quarry at Zichen on 23 December 1958, when 18 persons were killed, caused the mushroom farmers to leave Koeleboschgroeve permanently. At that time there had been 20 people employed at Koelebosch, of whom one shift of 12 had responsibility for preparing the manure. There are many inscriptions on the walls referring to aspects of mushroom culture including quantities of manure and dates of 'enting.' One drawing shows a moonlit couple embracing whilst seated on a bench: underneath is the inscription 'Pieke and Mia 1958' reminding us of the famous Pia Ronda who had grown mushrooms in the northern galleries at St. Pietersberg before his employment at the Koelebosch farm. Other silent reminders of the industry are provided by the deep wells and reservoirs made for water for sprinkling the manure and for disinfecting purposes.

Underground mushroom culture in the Dutch and Belgian quarries near Maastricht is now almost extinct. The last site that had to be abandoned before its lease expired was the quarry Viltergroeve. This was a very suitable location for an

underground mushroom farm - warm, ceilings not too high, and having regularly proportioned galleries allowing good separation of cellars. Viltergroeve would have made an excellent cultural-historical monument to the industry, being in pleasant surroundings which attract numerous tourists. The only mushroom cultivation still carried on underground on the Dutch side of the border is in a small area in the northern gallery system at the St. Pietersberg quarries.

The negative aspects of the trade - the smelly underground fermentation, the raising of quarry air temperatures, the use of poisonous chemical disinfectants such as DDT, and the disturbance caused by the workforce - have all adversely and seriously affected the hibernating bat populations. However, declining bat numbers are also in part attributable to the loss of surface summer roosting places; and the more modern underground cultivation methods were considerably less inimical to bats. Strangely, it was a Mr. and Mrs. Bels-Koning, whose original interest in the quarries was in looking for bats, who in 1945 established a laboratory devoted to researching underground mushroom cultivation methods. This establishment, enjoying some

Government support, was located at Houtem - Sint Gerlach. It investigated mushroom varieties, tested manures, and provided a support service for local growers. But above-ground cultivation techniques were perfected in the 1950s, the laboratory was closed in 1952, and the Bels-Koning family emigrated to start mushroom cultivation in Canada. And so this underground industry is now very nearly at an end in the Netherlands.

EDITORIAL NOTE

Text translated by Joep Orbons and edited by Paul W. Sowan, 1995.

Additional information on the Dutch and Belgian underground quarries in the Maastricht area, and on underground cultivation of mushrooms, may be found in the following papers:

GAFFARD, E., Underground farming. *Bull. Subterranea Britannica* 30, 2 - 6, 1994.

GAFFARD, E., Underground farming, *Bull. Subterranea Britannica* 30, 2 - 6, 1994.

TADD, M.H., History of growing mushrooms underground, *Bull. Subterranea Britannica* 27, 11 - 24, 1991.

From the literature ...

UNDERGROUND QUARRIES NEAR WIGAN

These flags occur in the lower beds of the Coal Measures, and are quarried both in open work and by shafts, for a distance of 10 miles from north to south, along a ridge of high ground.

HUNT, Robert, 1860, Mining records. Mineral statistics of the United Kingdom of Great Britain and Ireland. Being Part II for 1858, *Memoir Geological Survey*, pages 212 - 213 and 222 - 223.

[The Upholland flags were quarried at Billinge Hill, Upholland, and Apply Bridge, near Wigan (Lancashire) and used for roofing, floors at St. George's Hall, Liverpool, and for grindstones.

The Trustees of the Edleston Charity Trust are recorded as freeholders, and Thos. Tasker, Thos. Livesey, and George Morris as quarrymen]

PROBLEMS of ARCHITECTURAL and ARCHAEOLOGICAL RESEARCHES and MUSEUM MANAGEMENT of CAVE MONASTERIES at KIEV, UKRAINE

MAXIM N STRIKHAR, Senior Research Assistant, Underground Kiev Department, Museum of History, Kiev. UKRAINE, KIEV 166-253166, Zhukov str. 24, apt. 123.

Abstract: Museum guardianship and archaeological investigation of three of the 'minor' sets of caves associated with present or former monasteries, more or less abandoned by the Church in Kiev, has thrown up the problems associated with under-funded urban archaeology, and of museum management of underground sites which it is argued should (following investigation) be conserved as stabilised monuments of great cultural importance. There are lessons for further such work in Kiev.

Keywords: Ukraine / Kiev / monasteries / catacombs

INTRODUCTION

There are about ten large cave-monasteries in Kiev. They were created at various dates between the 11th and 19th centuries, although exact dates for particular sites are not usually known. The cave monasteries are situated on the right or western bank of the river Dniepr, throughout modern Kiev and its immediate environs. The caves are dug in sandstone (the 'Near' and 'Far' caves and the associated Varyazhskie caves in the still active Kiev Pechersk Lavra monastery area); and loess, sandy loam and loam (Kitaevskie, Zverinitskie, and Gniletskie caves of the Sophia and Michael Zlatoverkhy monasteries, and others.) The caves are from three to 20 metres below present-day ground surface levels.

Inside the cave complexes there are features such as straight or curved narrow galleries; cubacula, cells, underground chapels and churches; and arcosolia and loculi. Whilst some of the loculi are, as in Rome, parallel with the passages, many are at right-angles to them.

The most famous caves are the 'Near' and 'Far' caves and the partially lost Varyazhskie caves at Kiev Pechersk Lavra, in the 'caves district.' The Near and Far caves remain in use by the Russian Orthodox Church, as places of pilgrimage and prayer, and have been seen and

described by many thousands of visitors to the city, and such visits have continued unabated through the transition from USSR state control to church administration. Currently, the Ukrainian state takes regrettably little interest in the conservation of the Lavra caves, although these have been listed by UNESCO as a World Heritage monument.

MUSEUM of KIEV HISTORY

During 1989 a 'Kiev underground' Department was established at the Museum of History at Kiev. The new Department's objectives are to catalogue the 'caves', conduct archaeological investigations in them, and consider their management. The Museum has assumed responsibility for the Zverinitskie caves (11th - 18th centuries); the Kitayev caves (17th - 19th centuries) of the small secluded St. Trinity monastery; and the caves memorial complex (11th - 17th centuries) of the secluded Gniletskie Monastery of the Nativity of the Virgin. When transferred to the Museum, these caves were on the verge of complete destruction. Parts of the underground galleries had been demolished. Burials had been exhaustively plundered. Casual modern visitors had left graffiti on the walls.



Some of the Monastery Caves at Kiev Plan published in 1668



Another plan of Monastery Caves at Kiev Plan made in the 17th Century

UNDERGROUND ARCHAEOLOGY and ASSOCIATED PROBLEMS

The Museum has cleaned and restored the caves in its care, and conducted engineering-geology and micro-climatic studies. Zverinitskie and Kitayevskie caves are now in a fit state for the reception of visitors. However, unforeseen problems are emerging, as a result of a lack of previous museum cave-management experience, and of the termination of finance for cave restoration. It had not been appreciated that the caves are an integral part of the biosphere. The caves host micro-organisms, insects, and bats. Underground monasteries served as dwellings, places for prayer and shelter, and burial-places for the monks for many centuries. Thus they represent concentrations of biochemical energy. Believers, too, think in terms of sacred ground where prayers have been offered and burials made for many centuries. Modern intervention calls for great care, and the consequences of thoughtless invasion cannot be predicted. The Kiev History Museum and its subcontractors made a number of mistakes, and unwittingly caused some damage underground. Restoration work, too, was adversely affected by the political and economic situation in newly-independent Ukraine.

Kitayevskie caves were 'captured' by the monks of the St. Trinity Monastery who, declaring themselves 'God's people' asserted 'we know better', destroyed archaeological stratification, and rearranged the cave interiors.

At Zverinitskie, restoration was carried out according to the 'quickest and cheapest' principle, resulting in the loss of ancient Russian-period graffiti. Where the crowns or arches had collapsed, cheap reinforced-concrete roof-support was installed. Lime-cement plastering was applied to walls. Ventilation was not adequately thought out.

These several measures led to a 'hot-bed' effect underground, and a biological chain reaction. Micro-organisms and fungi flourished. During mycological investigation in 1995, 23 species of fungi were recorded, including *aspergillus repens* which is a hazard to man. Increased air temperatures and humidity caused the distension and collapse of wall-plaster, and exfoliation of bedrock inside burial chambers and underground churches.

Zverinitskie caves can be saved from further damage, but considerable financial resources are needed - significantly more than expended on work to date.

A main cause of cave damage is archaeological investigation. The removal of cave 'fill' has led to stress relief and distortion and collapse of walls and arches.

LESSONS for the FUTURE

One of the main purposes of archaeological investigation of the caves is to obtain information which can throw light on the history of their creation and development. During the process of archaeological investigation we often forget about the conservation of the features we are studying. For this reason many of the caves in Kiev, dug in loess and sand, there appears to be a sequence of events ...

- 1 Data collection
- 2 Data processing
- 3 Writing and publication of reports
- 4 Cave deterioration
- 5 Work on cave reanimation

The lessons to be drawn from experience at Kiev suggest that mistakes from the past should be avoided in future. Further archaeological investigation should be reduced to a minimum, and should be carried out alongside cave conservation measures. Museum management should recognize the caves' individual peculiarities, and their status as architectural and historical monuments.

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KONDRATYUK, T.O., I.O. KOSTIKOV, and O.M. KOROGOD, 1996, *Biodestruction of the Zvernetskie caves, Kiev*. UNDRTS.

Problems of protection, investigation and restoration of architectural monuments of Kiev-Pechersk Lavra, Kiev, 1991 [Collection of articles]

KALACHEV, V.Y., and S.N. MAKSIMOV, 1991, *Engineering construction*, MOSCOW.

KLIMCHUK, A.B., and A.D. AKSEM, 1990, *Report on the contracted scientific research work ... scheme for development of Zverensky caves for excursions*, KIEV: IGN of UKRAINE.

Ukrainian terms ...

Kaboa = Lavra – monastery

Oeveop\ a = Pechersk – caves

Archaeological terms ...

Arcosolium (*pl. arcosolia*) – an arched tomb, often within a cubiculum; the grave was made in the lower part of an arched recess in a wall, covered with a mensa (a stone or marble shelf), and decorated in front.

Cubiculum (*pl. cubicula*) – a tomb chamber containing the graves of several people made in the walls or floor; cubicula often contain arcosolia.

Locus (*pl. loculi*) – a simple grave within a catacomb, inserted within a wall of a passage or gallery, usually parallel with it, and sealed with a marble or stone slab or tiles; may contain more than one burial.

Definitions from Antonio FERRUA, 1991, 'The unknown catacomb: a unique discovery of early Christian art', NEW LANARK: Geddes & Grosset Ltd.

ZMAJEVA ŠPILJA

Vlado Božic

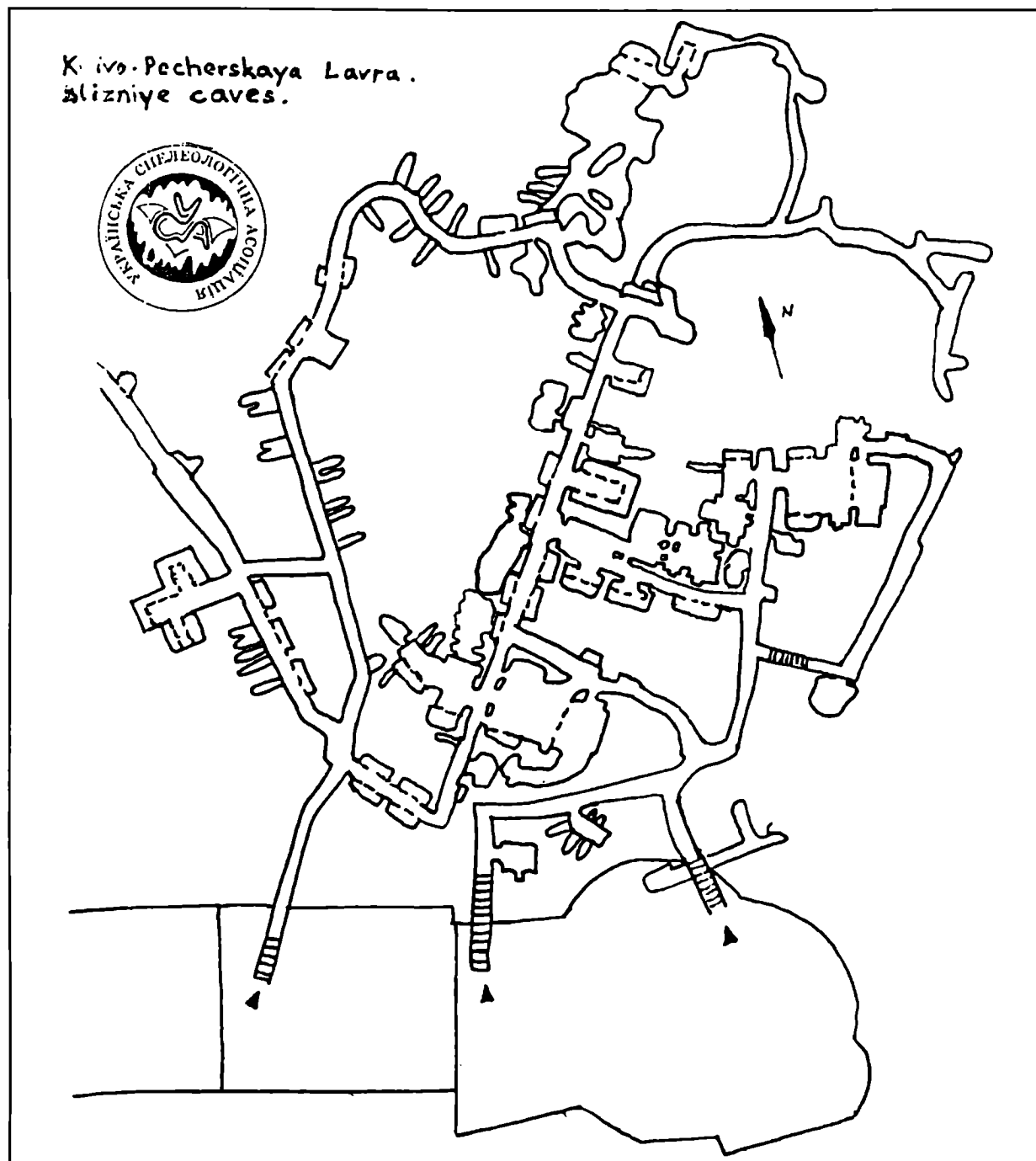
A recent issue of the journal *Speleolog*, published in Zagreb (Croatia), contains an article on the 'Dragon's hole' on the island of Brac, to the south of Split. The English abstract is reproduced here:

Dragon's Hole (Zmajeva Špilja)

There is a small cave only about twenty meters long, located about 5 km from the touristic city of Bol in the southern part of the Brac island, which hosts a monastery built in 15th century by Glagolitic monks. They have moved here from Poljica near the city of Split seeking exile from Turks. They built a high wall for protection in front of the cave entrance, a water tank, a chapel and living quarters in the cave. They made several bas-reliefs in the bare rock, and the largest as well as the nicest is a dragon scene, after which

the cave was named. Other outstanding reliefs portray a lion with devil's head in claws, the half-moon shaped as human head, a pelican, a king and a queen, an angel, etc. In 1986 Ante Skobalj, a priest from Brac, gave explanation of those reliefs based on comparison with the gospel. A dragon in ancient Slavic mythology represents the master of darkness (that is why it lives in a cave) and the personification of evil. The scene of half-moon and dragon represents a fight of the Good and Evil, the scene of lion with devil's head symbolizes the victory of the Good over the Satan's forces. There are explanations to the other figures, too. It is proposed that the cave should become a site under the state protection as a cultural, historical and natural heritage monument.

BOŽIC, Vlado, 1997, *Zmajeva Špilja*, Zagreb: *Speleolog* 42/43 (for 1994 – 1995), 17 – 21 [English abstract on page 21]



The Blizniye (Near) Caves at Kiev *Ukrainian Speleological Association*

Visit report by the Editor ...

ADDITIONAL NOTES ON THE MONASTERY 'CAVES' at KIEV, UKRAINE

I visited Kiev, at the end of a short excursion in Ukraine, at Easter 1996, in the company of Ton Breuls (Belgium) and David Havlicek (Czech Republic.) We were the guests of the Chortkiv group of the Ukrainian Speleological Association, and were taken to see some of the 'caves' and the History Museum's 'Caves gallery' by Maxim Strikhar.

KIEV PECHERSK LAVRA

Kiev, the capital of Ukraine, is an older city than Moscow, and was anciently centred on the right (west) bank of the river Dniepr. It was founded in the 9th – 11th centuries, and was the birthplace of the Russian Orthodox Church. St. Sophia's Cathedral dates from 1017 – 1031. Some 3.5 km to the south, overlooking the Dniepr, is the Pechersk (Caves) district of the city, although in fact artificial caves made in the loess of the river terrace exist over a stretch of several kilometres of the west bank, and are not restricted to the Pechersk Lavra (Caves Monastery) area. Pechersk Lavra is a beautiful site, well wooded and with staggering quantities of mistletoe in the trees. The numerous white-painted monastery buildings, and the churches with green and gold domes, have for years been a tourist attraction although, in fact, the monastery is almost exclusively devoted to its proper purposes of prayer and worship.

THE NEAR (BLIZNIYE) and FAR (DALNIYE) CAVES

'Caves', catacombs, underground chapels, and the like, have been made in the Pechersk district from the 9th century onwards. Some are now lost as a result of roof-falls or war damage (e.g. the Varyiazskie caves), and some of the lost

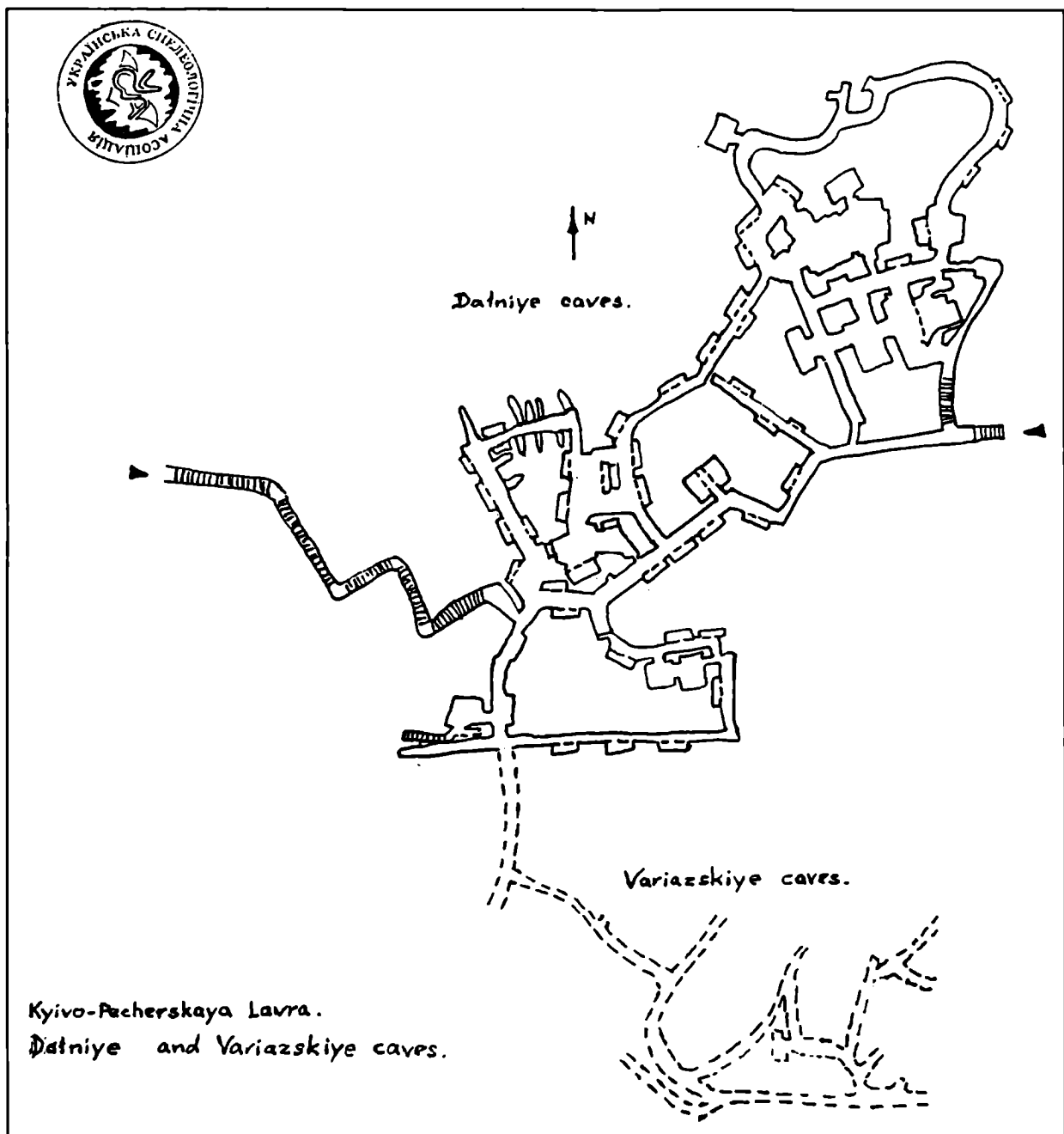
tunnels reputedly still contain treasures hidden in them during World War II. Occasionally, small collapses affect the surface.

Both of the publicly accessible cave systems, the 'Near' and 'Far' caves, are entered from within church buildings. No charge is made, although visitors are expected to purchase small candles which do little to supplement what little lighting there is underground. The caves are first and foremost religious sites, and certain parts are not opened to the public. At the time of our visit, we were (quite properly) outnumbered by Ukrainians visiting for devotional purposes. Photography is not allowed. A monk followed our party at a discreet distance, always halting behind the last corner – his footsteps stopping when ours stopped.

The tunnels are of the order of 1 metre or slightly more wide, and usually lined and whitewashed, so the loess bedrock cannot be seen. Within, there are religious paintings, altars, and so forth. Mummified monks, decently covered by ornamented cloths, lie in glass-topped open coffins. Small chapels open off from time to time, some of them decorated in a somewhat ornate 19th century style.

Other burials are in sealed loculi in the tunnel walls. An interesting contrast with the Roman catacombs is that at Kiev many of the loculi are at right-angles to the narrow passages, rather than parallel with them. This no doubt aided tunnel stability in the mechanically weak loess, although both excavation of body-sized holes up to two metres from front to back, and interment, can hardly have been easy.

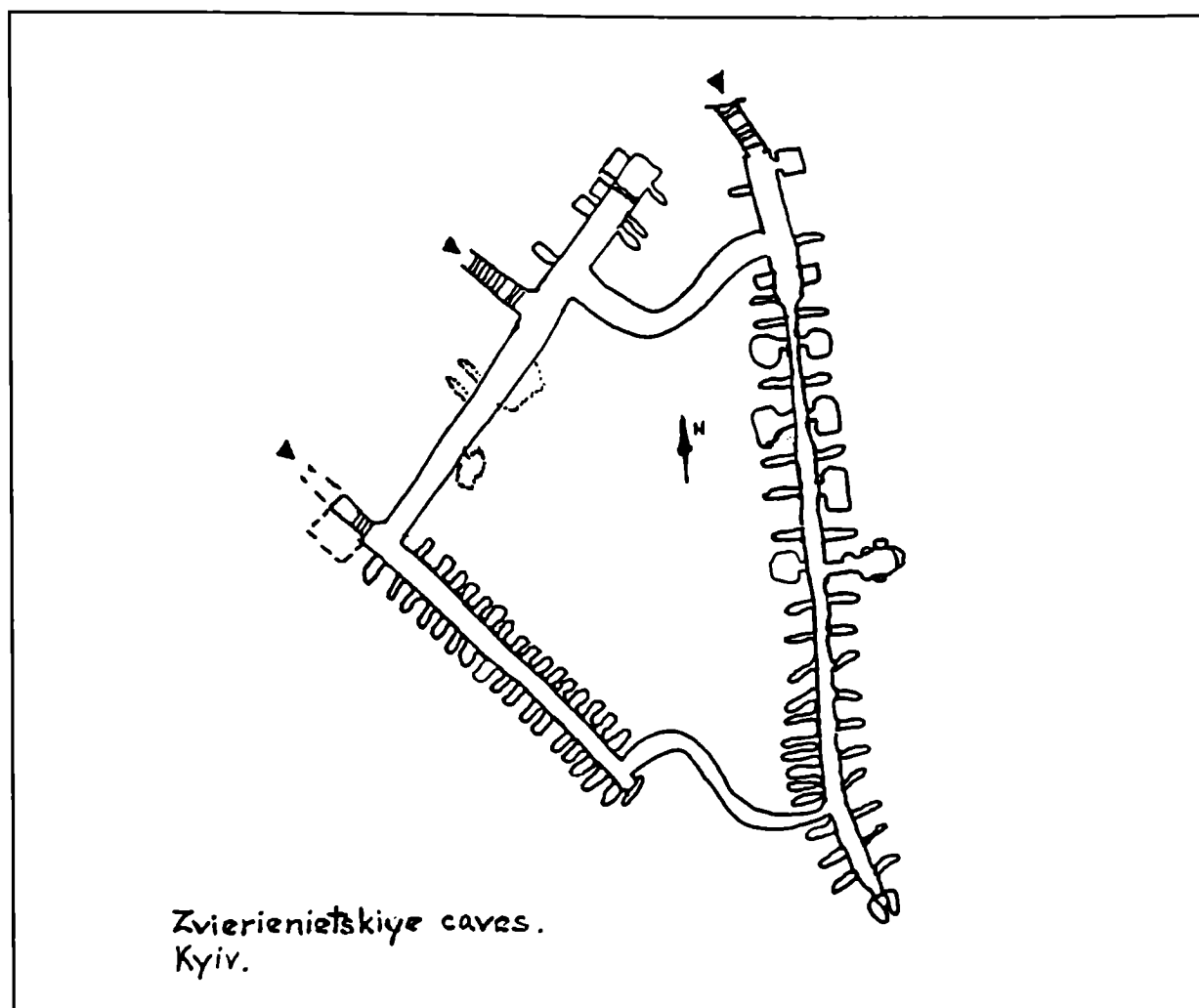
The 'Far' caves are said to be the older of the two systems, originally made, perhaps, by robbers to hide stolen goods in the



The Dalniye (Far) and Variazskiye Caves at Kiev *Ukrainian Speleological Association*

9th – 10th centuries. The evidence for this was not clear to us. The 'Near' caves were reputedly started by a monk, Anthony, in the 11th century. In time the monastery extended over both systems. Under Soviet administration, the caves' stability and microclimate were monitored. But today the church administration has ceased this

work, and removed the instrumentation. Nevertheless there is some anxiety for the long-term stability of the caves and their contents (and presumably the buildings above them.) Some ground movement, witnessed by cracks in the walls of buildings, is supposed to be related to changes in drainage in the area.



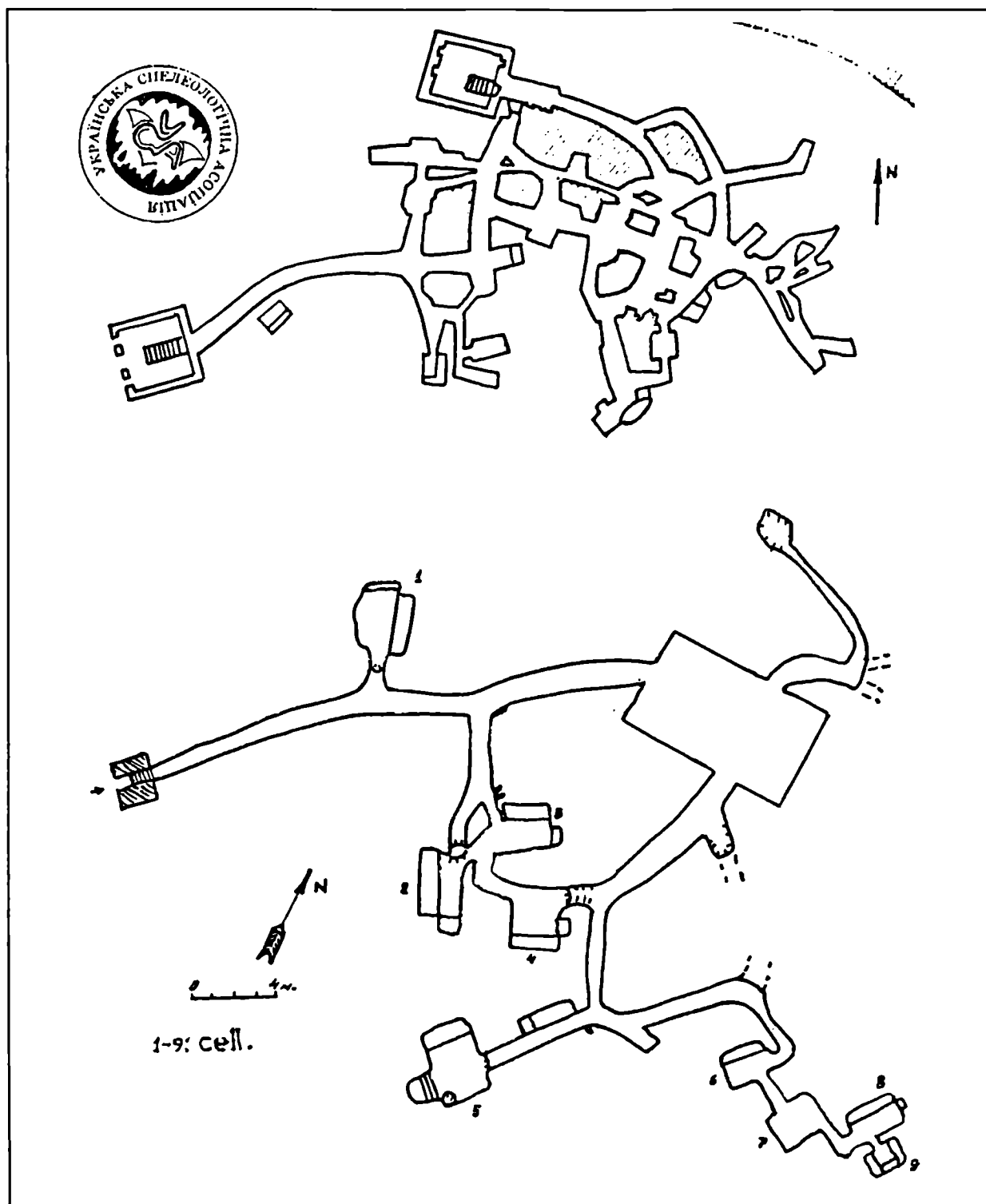
The Zvierienietskiye Caves at Kiev *Ukrainian Speleological Association*

ZVERINITSKIE

The Zverinitskie caves, further south, are a complete contrast. They are entered by way of a private back-garden. This system, long abandoned by the church, was rediscovered in 1883, blocked up again about 1885, and reopened in 1911. There have been finds dated from the 13th – 15th centuries, and the 'cave' itself is thought to have been made from the 10th century onwards. The tunnels were damaged about 1917 by the explosion of gunpowder which was being stored in them; however, this accident revealed additional lost tunnels! The system was sealed again in the 1930s, and reopened for archaeological recording in 1990. Substantial parts of the main tunnel wall are lined, but several cubacula are cut in unlined loess, and contain a few skeletal fragments.

KITAEVSKIE

These 'caves' are on two or three levels, near the top of a small wooded hill, further south along the river bank again. The hilltop boasts a hill-fort. We were unable to obtain admission, as a result of some confusion about keys. During 1996 a solitary monk was in residence at the top of the hill in a small 'cut-and-cover' cave of his own construction, roofed with reused building materials and polythene sheet. His devotion to his religious duties could hardly be doubted, as he had, nearby, excavated an entirely new and completely subterranean 'cave monastery' of his own, including a flight of 20 or 30 steeply descending steps which led by way of a couple of left-hand turns to a small cell with an altar, of the order of three metres below ground.



The Kitaiv Caves (on two levels) at Kiev *Ukrainian Speleological Association*

Visit report ...

AN UNDERGROUND BUILDING-STONE QUARRY AT BOCHOTNICA, POLAND

Paul W SOWAN, 254 Pampisford Road, SOUTH CROYDON, Surrey CR2 6DD

Bochotnica is a hamlet on the eastern bank of the Wisla [Vistula] river, about six kilometres north of Kazimierz Dolny and 12 kilometres south of Pulawy. The quarry is in a steep wooded hillside of Cretaceous limestone.

An area of approximately 1,350 square metres has been quarried, the irregular pillar-and-stall pattern being strongly influenced by a series of parallel joints at spacings of a few metres. Pillar dimensions ranged from about 1.5 to 4 metres, many pillar sides being joint-planes. No tool-marks were seen. Although there was much fallen material on the quarry floor, the floor-ceiling height could be seen to be of the order of four to five metres.

Local information was that the entire quarry had been the work of one family since World War II, and that only iron bars,

wedges, and hammers had been used, with lighting by oil lamps. Two further small opencast quarries nearby appeared to be in continuing use for purely local needs for random rubble nearby, in one of which a new underground working was observed to have been commenced, extending (in September 1999) as a single drift less than 10 metres long.

No evidence of the ancient quarries which would have supplied stone for the 13th - 14th century castle, churches, or granaries at Kazimierz Dolny was seen.

SOWAN, P.W., Building-stone mines in the Upper Cretaceous in Holland and Belgium, Parts I - II, *Bull. Subterranea Britannica* 12, 3 - 9; and 13, 3 - 9, 1980 - 81.

TADD, M.H., History of growing mushrooms underground. *Bull. Subterranea Britannica* 27, 11 - 24.

From the literature ...

THE SALTWOOD TUNNEL SAND-MINES, KENT

As the [shaft] sinking proceeded, notes were taken of every change of strata, which, at the same time that they were interesting as geological facts, were occasionally useful afterwards. For instance, in sinking the trial shafts at Saltwood, we passed through a stratum of clean sharp sand, well adapted for gauging with cement. In the course of our subsequent work such sand became a desideratum, and all we had to do was to break through the brickwork of each shaft, at the particular level pointed out by the memoranda, and a man threw down into

the tunnel as much as was required; excavating it as a driftway. Thus a plentiful supply of excellent sand was obtained at a cheap rate.

SIMMS, Frederick Walter, 1844, *Practical tunnelling ... as exemplified by the particulars of the Blechingley and Saltwood tunnels*, page 51.

EDITORIAL NOTE ...

The tunnel, still in use at TR 1536 on the line between Sandling and Folkestone West, was made in 1842 - 43. It is 954 yards long and has 12 shafts.

SUBTERRANEA BRITANNICA PUBLICATIONS AND INFORMATION SERVICE

BULLETIN - Issues 1 - 22 were issued 1975 - 85, paper-covered, usually with 16 pages per issue. Issues 23 - 30 were issued 1986 - 1994, with card covers, usually with 40 pages per issue. A general index to issues 1 - 20, 1975 - 1984, was issued in 1984.

NEWSLETTERS - Members' Newsletters have been issued several times each year since 1984. *Some back issues are available, as are photocopies of out-of-print issues or individual articles at cost price plus postage and packing. Enquiries should be sent to the Editor.*

SB GUIDES - A series of very short 'beginners' guides' has been commenced, with a maximum length of four A4 pages each.

Currently available are:-

- (1) *The geological literature as a source for industrial history* (2 pages),
- (2) *Underground industrial archaeology in Kent* (4 pages),
- (3) *Wells in Kent* (3 pages) and
- (4) *Deneholes and chalkwells* (2 pages.)

Further titles are in preparation. *Copies will be supplied by the Editor at 10p per page to cover printing and postage.*

INFORMATION

Subterranea Britannica does not maintain a *library*. Any unique archival material received is deposited in an appropriate recognized records office. British and foreign periodicals and other items received are eventually deposited in suitable specialist libraries. Subterranea Britannica does however operate an *information system* and enquirers can be informed about *what has been published* on many underground sites throughout Europe, and often advised *where such material may be consulted*. This applies to books, articles in periodicals, pamphlets, and so forth. Researchers should know that the public library services are able to obtain on loan or as photocopies almost anything published in English or major European languages, provided reasonably precise bibliographical data (which SB can often supply) is provided. And many, at least, can make the British Library Catalogue of Printed Books available on CD-ROM or on-line.

The Editor and several other members have extensive personal libraries and research files, and will usually be pleased to assist members and others with serious research. The Editor is currently compiling a bibliography of works relevant to the archaeology and history of the extractive industries - mining and quarrying - throughout the British Isles. This is added-to daily, and currently contains over 8,000 pages. From time to time it is made available to researchers electronically, on disc, for the price of discs, postage and packing. This is available, and revised from time to time, at :-

<http://wkweb4.cableinet.co.uk/adrian.pearce/BMD.HTM>

A similar bibliography concerning the civil engineering of tunnels of all kinds, and transport-infrastructure earthworks, is also being compiled. *Paper copies are not distributed. All enquiries should be directed to the Bulletin Editor.*

